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PRINCIPAL INVESTIGATOR: Grace K. Lemasters, Ph.D.

CONTRACTING ORGANIZATION: University of Cincinnati
Cincinnati, Ohio 45267-0553

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13. ABSTRACT *(Maximum 200*

Jet fuel, one of the most prevalent exposures at all Air Force (AF) bases, is composed of compounds that have potential deleterious effects on reproductive health. Therefore, this study was conducted to determine the feasibility of a prospective investigation of female AF military and civilian personnel for potential adverse reproductive health effects associated with jet fuel exposure. Toward this end, two technical objectives were addressed: 1) the number of female AF personnel was evaluated and it was determined that an adequate sample size for the measurement of menstrual and hormonal outcomes in the prospective study could be achieved by the inclusion of four AF bases; 2) low dose exposure to jet fuel analytes including benzene was characterized. Also, it was determined from one collateral investigation that chronic, low level exposure to solvents may produce subtle, long term neurological effects manifested as postural balance impairment. Postural sway is a sensitive biological marker of neurological changes associated with chemical exposures.

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FOREWORD

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PI - Signature   Date

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Acknowledgments

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Our investigation was made possible through the insights, talents and investment of Wright Patterson AFB collaborators Captain Kim Trinh and Dr. David Mattie. We also thank our University of Cincinnati staff for their tireless efforts.

A FEASIBILITY STUDY OF AIR FORCE MILITARY PERSONNEL AND JET FUEL EXPOSURE. University of Cincinnati Investigators: Grace K.Lemasters, Susan Simpson, Amit Bhattacharya, James Lockey, John Lu, Donna Olsen, Edward Puhala, Glenn Talaska,; Air Force Investigators (alphabetical order): Col. Richard Henderson, Col. John Joyce, David Mattie, Major Leslie Smith, Captain Kim Trinh

Executive Summary:

Fuel exposure is probably the greatest single chemical hazard in terms of volume used of any in the armed forces and total consumption ranks in the billions of gallons. Jet fuel is composed of aliphatic and aromatic hydrocarbons that are related to adverse reproductive health effects including infertility, fetal effects and menstrual disorders. Among the four Armed Services, the Air Force has the second highest proportion of female active duty personnel (34%). As of 1995 there were approximately 52,000 active enlisted women in the Air Force. Ninety-six percent of these women are under the age of 40 and in their prime reproductive years. Little attention has been given to the potential reproductive health effects to young women of chronic, low-level jet fuel exposure. Therefore, "A Feasibility Study of Exposure to Jet Fuel at USAF Bases" was funded by the DoD in order to determine the appropriateness of a prospective reproductive study of female AF personnel having jet fuel exposure. This feasibility study addressed two technical objectives. The first objective was to determine if there were a sufficient number of female AF personnel exposed to jet fuels. **It was determined that a large number of jobs across USAF bases are held by women who have almost daily contact with fuels.** It also was determined that an adequate sample size for the measurement of menstrual and hormonal outcomes in the proposed prospective study was achievable by including four to five AF bases. The second technical objective was to conduct industrial hygiene sampling estimating exposure to jet fuel analytes. **Study results showed that, generally, exposure levels were well below the TLV.**

This investigation also revealed that female military personnel are concerned about the health consequences of their exposure to fuels. Statements such as "If I was to become pregnant what are the possible effects of past exposure", and "I'm concerned about working inside fuel tanks and having fuel get on clothing and

breathing vapors" were voiced by the participants. In fact, of the 18 women included in the study and having jet fuel exposure, 61% expressed health concerns. An additional and very important finding was that Base Commanders also are interested in this issue, and some bases actually requested to be included in this or any future study.

In three collateral studies it also was found that: **1) chronic, low level exposure to solvents may produce subtle, long term neurological/ neurobehavioral effects;** 2) exposures to naphtha, benzene and xylenes were higher among female than among male AF personnel and was primarily attributable to the magnitude of womens' exposures at one AF base; 3) a potential new method to economically monitor nitroaromatic compounds was evaluated but failed to be sufficiently sensitive at these low exposure levels.

In conclusion, the results of this study supported the feasibility of a follow-up investigation of hormonal changes and/or menstrual disorders in women exposed to fuels. Based on preliminary findings from this study, a follow-up investigation entitled "Female Reproductive Effects of Exposure to Jet Fuel at U.S. Air Force Bases" was recently funded by the DoD (September, 1996). The follow-up investigation will address whether or not women are experiencing adverse endocrine or menstrual symptoms in association with their workplace exposures. Reproductive disorders have both health and economic impacts. **Nationwide, the cost of missed work days associated with menstrual dysfunction is between 94 and 308 million dollars per day missed. This upcoming study presents an opportunity to expand upon the findings of the feasibility study with a unique partnership consisting of the University of Cincinnati, the U.S. Department of Defense, and the National Institute for Occupational Safety and Health; an expert multidiciplinary team building on a decade of collaboration.**

I. Introduction

A. Overview

1. An Overview of Jet Fuel

A total of nearly three billion gallons of jet fuel were purchased by the United States Air Force (USAF) in fiscal year 1995[1]. The ensuing handling of this large volume results in one of the primary exposures in the military today. Jet fuels, as a group, consist of a variable mixture of hydrocarbon compounds whose specifications are based upon burn characteristics and additives. Currently, JP-5 and JP-8 are the principal types of jet fuel that are in use. JP-4 was recently replaced by JP-8 as JP-8 has reduced flammability and benzene content, higher efficiency and cleaner burning properties.

Information obtained from investigations of military exposures may have implications with regard to exposures encountered in the private sector and among the general public as similarities exist between jet fuels and a variety of other fuel types. Carbon chains C_4 to C_{14} are constituents of the JP-4 jet fuel mixture while automotive fuel is characterized by carbon chains of C_4 to C_{11}, diesel fuel of C_{10} to C_{19} and stoddard solvent of C_7 to C_{12}.

Animal studies of jet fuel exposure have demonstrated both neurotoxicity and skin defatting with irritation. Nephrotoxicity

and renal carcinogenicity were also noted but were reportedly specific to male rats and inapplicable to humans[2]. There have been few conclusive studies of jet fuel toxicity in humans. Occupational studies of Swedish civilian and military aircraft workers described adverse neurological outcomes related to long-term jet fuel exposure[3-5]. Observations from these investigations included a significant increase in neuro-psychiatric symptoms, neurasthenia and a trend suggesting polyneuropathy. The National Research Council's Committee on Toxicology (NRCCOT) noted that interpretation of the above mentioned findings is complicated by methodological problems inherent in these investigations, such as inadequate control of potential confounders and disputable evidence of impairment[2]. Based on the limited information that is available, however, the NRCCOT has recommended an increase in the Navy's permissible exposure limit (PEL) from 300 to 350 mg/m^3 and a decrease in the short-term exposure limit (STEL) from 1,800 to 1,000 mg/m^3 pending the completion of further research.

2. Reproductive, Cytogenic and Endocrine Effects

Although there have been limited reproductive, toxicologic and developmental studies of aliphatic hydrocarbons, there has been substantial research on aromatics. Specific studies of JF toxicity are few. Struwe et al., 1983, observed cases of sexual dysfunction

among a small subgroup of workers with long-term occupational jet fuel exposure[3]. Pregnant rats given JP-8 orally showed significantly lower maternal and fetal weights; however the number of fetal malformations observed did not differ significantly between the exposed and control groups. Such results may indicate that JP-8 is a developmental toxin in the rat at certain doses, but it probably is not a teratogen[6]. Preimplantation loss was observed in an earlier JP-4 rat exposure study. Among petrol workers (exposed to hydrocarbons), 50% of women over age 40 reported menstrual disorders compared to 18.7% of age-matched controls; 21% of those workers who were exposed experienced menorrhagia versus 8.3% of controls[7]. The positive findings of cytogenic studies of workers exposed to gasoline are also important as this fuels shares components with JF; i.e., automotive gasoline is composed of several hundred hydrocarbons in the range of C_4 to C_{11} and JF is C_4 to C_{14}[8,9].

While relatively few studies of the reproductive effects of fuels exposure have been conducted, there is a substantial body of research on the effects of benzene, toluene and xylene. Animal studies in several species have implicated benzene as a fetotoxin causing skeletal variants, growth retardation, and blastocyst reabsorptions in female reproductive studies[10-14]. A significantly

increased frequency of chromatid and isochromatid breaks and sister chromatid exchanges has been observed in the children of women occupationally exposed to benzene and other solvents[15]. In rat studies, the xylenes have been associated with fetotoxic effects of decreased fetal weight, skeletal retardation, pre- and post-implantation loss and both increases and decreases in placental weight[13,16-18]. Case studies of the children of women exposed to toluene and mixed solvents during pregnancy have reported adverse developmental effects including, CNS effects, attention deficits, variable growth, intrauterine growth retardation, and minor craniofacial and limb abnormalities[19-21]. Menstrual dysfunction, dysmenorrhea and increased cycle duration, were significantly increased in leather shoemakers and drycleaning workers exposed to toluene, benzene and perchloroethylene[22-25].

In summary, many of the components of fuels are known or suspected neurotoxic, genotoxic, mutagenic or reproductive toxicants. Female recruits are young, inexperienced and often unsophisticated in their understanding of the potential for adverse health effects associated with workplace exposures. Their opportunities for exposures and possible toxic effects are compounded when large quantities of fuel are handled as is the case in the military and avionics industry. Even at low levels of

exposure, the large fuel volumes may lead to significant cumulative exposure concentrations.

B. Study Purpose

The primary purpose of this investigation was to assess the feasibility of conducting a prospective investigation of female Air Force military and civilian personnel for potential adverse reproductive health effects associated with jet fuel exposure. The overall null hypothesis of this feasibility study was that relatively few women were in contact with jet fuels at USAF bases and their exposures were negligible.

C. Scope of Research

The current investigation was developed and implemented by a multidisciplinary team which included University of Cincinnati and Wright Patterson Air Force Base. In order to explore key feasibility issues, current jet engine fuel exposure was characterized by industrial hygiene (IH) monitoring and gravimetric analysis of ambient and personal air levels of jet fuel exhaust for women and men at USAFBs. Exposure levels were then cross-referenced with USAF personnel data to evaluate the number of female employees in the most highly exposed jobs.

In addition, several subprojects were conducted. These projects included: an evaluation of current versus historical

exposure concentrations of jet fuel; a comparison of the exposure levels of female and male AF personnel; laboratory testing of a nitro-PAH biomarker developed by Dr. Glen Talaska; and a collateral evaluation of the neurological effects of jet fuel exposure. The neurological assessment project was conducted as thesis research by Air Force Institute of Technology sponsored graduate student Major Leslie Smith under Dr. Amit Bhattacharya, Biomechanics Laboratory in the Department of Environmental Health.

In order to determine if a future investigation of jet fuel and adverse reproductive effects in women would be feasible and relevant, the following technical objectives were accomplished:

Technical Objective 1: to determine if there is a population of female air force military and civilian personnel adequate in size to provide the statistical power for hypothesis testing.

Technical Objective 2: to characterize the level of jet fuel exposures using industrial hygiene (IH) sampling measures.

D. Background of Previous Work

The implementation of this study involved several steps including: 1) base selection following preliminary communications with knowledgeable base personnel and historical exposure data collection and review; 2)identification and recruitment of subjects with probable jet fuel exposure; 3) industrial hygiene monitoring at selected bases; 4) computerization and analysis of air sampling data; and 5) collection and analysis of summary military personnel/demographic data for USAF bases.

Historical exposure and demographic data were used in a selection process to identify base locations and sampling areas for investigation. Data were requested from eight domestic USAF base locations and received from six. The data received had been either drawn directly from the Air force's Phoenix database system of exposure concentrations or abstracted by the individual bases from their records. The data had been collected between the years of 1987 to 1995. This information included locations by zone of previous sampling for jet fuel and its constituents, the analytical results of this sampling and gender compositions of base personnel populations by location.

Based upon historical jet fuel exposure levels, gender composition and base accessibility, three domestic USAF base

locations were chosen as sampling locations which are referred to in this report as bases A, B and C. The demographic and historical exposure data from these bases were then used in a pre-selection process which identified areas with the potential for elevated jet fuel exposures at each location. All areas of jet fuels use were initially investigated so as to not overlook any areas of potential exposures. The pre-selection process saved valuable time during the base visits and provided starting points for exposure identification.

The pre-selection process generated lists of zones and Air Force Specialty Codes/Occupational Series (AFSC/OS) of highest potential jet fuel exposure. This process involved the application of a selection algorithm which focused on the parameters of historical exposure concentrations and gender composition. These parameters were chosen to identify areas of mixed gender population with the highest potential exposure concentrations. The historical data were entered into the computer and sorted, using Statistical Analyzing System (SAS)[26], to generate a ranked list of time weighted average (TWA) exposures by analyte, JP-4 and benzene. The list was then checked to assure that the elevated concentration identified were representative of other exposures within the same zone. This sorting produced a ranked list of zones of potentially elevated

exposure to jet fuel. This list was then cross-referenced against the reported number of female personnel to yield a ranked list of zones by both TWA and number of female personnel. The AFSC/OS corresponding to these zones were then abstracted from the historical information resulting in a single document which identified priority zones of historically high exposure, the AFSC/OS within these zones, and the number of associated female personnel.

On some occasions no, or limited, historical sampling data were available. In these instances, the bases provided a qualitative list of exposures trends. Such lists identified AFSC/OS within zones and the associated types and frequencies of chemical exposures. This information was provided by Bioenvironmental Engineering staff at the bases, the organization responsible for evaluating health and safety issues. From these lists, those zones and AFSC/OS associated with daily jet fuel exposures were extracted and noted as potential sampling areas. These locations then served as the starting points for on-site investigation.

II. Methods and Findings

A. Methods

1. Subject Identification and Recruitment

Upon arrival at each base location, knowledgeable persons were consulted as to the locations of current potentially exposed work groups. Walkthroughs were then conducted in the fuels work areas determined to present the highest potential for jet fuel exposures. Each walkthrough involved the firsthand evaluation of potential sampling locations. This evaluation included observation of activities and discussion with shop managers and workers. The process resulted in an efficient method of locating potentially exposed populations.

Following identification of those workers having contact with fuels, individuals were approached for their voluntary participation. The recruitment process involved introducing the potential participant to the study objectives. The subjects were informed that participation required the wearing of air sampling equipment for up to six, eight-hour shifts. The potential study participants were also informed that personal identifiers would be removed from all tables and reports. Only one individual declined to participate. This individual performed a job function which was similar to several other study participants. The overall

recruiting process was standardized by the use of an informed consent form (see Appendix A).

2. Industrial Hygiene Monitoring

Industrial hygiene air samples were collected in accordance with a sampling protocol developed prior to visiting the first base location (see Appendix B). Area and breathing zone samples were collected for both jet fuel vapors and exhausts.

Personnel air samples for vaporous jet fuel exposure were collected on charcoal sorbent tubes, in accordance with National Institute of Occupational Safety and Health (NIOSH) recommended methods 1550, 1501 and 1500 for naphthas, benzene, toluene, heptane and xylenes. Air samples for burned jet fuels, exhaust, were collected using 37mm teflon filters in accordance with the sampling protocol (see Appendix B). The sampling protocol developed for this study was an adaptation of the methods described by Gupta[27]. All collection media were obtained from SKC, INC. Charcoal tubes were of the type designated catalog number 226-01, lot #120 - a 50/100 milligram, two section, glass sorbent tube containing coconut charcoal. Teflon filters were of the type designated catalog number 225-17-04, a PTFE(teflon) filter with polypropylene web support and a 0.45um pore size. The air samples were drawn through the collection media using personnel air

samplers obtained from SKC, Inc. Model numbers 224-PCXR8 or 224-PCXR4. Calibration of these samplers was accomplished using an SKC, Inc. air flow calibrator, model number 709, which was factory calibrated against National Institute of Standards & Technology (NIST) test number IR-74-461 on 05/22/95 (see Appendix C).

In accordance with the developed sampling protocol, all air samplers were calibrated prior to, and following each sampling excursion. Before pre-calibration of any sampler, the unit was checked so as to assure that it was set properly into the low-flow mode, for sampling unburned jet fuel; and, into the high flow mode for sampling jet fuel exhausts. The pumps were also checked so as to assure that each unit was fully charged and in proper working order. Following this initial check, low flow manifolds were attached to the inlet ports of each sampler to be used for unburned fuel sampling via a length of tygon tubing. Lengths of tygon tubing without manifolds were attached to the inlet ports of those samplers to be used for jet fuel exhaust sampling. The samplers to be used for sampling unburned jet fuel were then calibrated to 200 cubic centimeters/minute (cc/min), while those units to be used for exhaust sampling were calibrated to 3.5 liters per minute (lpm). In both cases, samplers were calibrated with representative media in-line, using the air flow calibrator.

The calibration procedure began by wetting the walls of the calibrator cell. This was accomplished by drawing several soap bubbles through the length of the calibration tube, under negative pressure from the sampler. With this accomplished the sampler was brought to the desired 200 cc/min or 3.5 lpm flow rate. Low flow adjustments were made using an adjustable needle valve located on the low flow manifold while high flow adjustments were made using the flow adjustment screw located on the face of the sampler. Once the desired flow rate was obtained, three flow readings were collected and immediately recorded in the Calibration Log. These three readings were then averaged and the mean value entered as the pre-calibration flow rate. Successful calibration yielded three values each within a ten percent tolerance window of the others. With the pre-calibration procedure complete, the sampler was ready for use.

Calibrated samplers were taken to the areas where sampling was performed. Each recruited individual was given a sampler to wear for the sampling period. Upon distribution of the units, information was recorded on data sheets developed specifically for this investigation (see Appendix D). Data entered on the sheets included: sample number, pump number, flow rates, sampling date, start/stop times, individuals name and rank, AFSC/OS, date of

birth, job description, job location identifiers and the answers to three work history-type questions. With the needed information recorded, the sampling tubes were opened, inserted into the sampling inlet of the low flow manifold, and the sampler turned on. A protective cover was utilized in order to cover the glass sampling tube and to protect both the wearer and the media. The unit was worn at the waist by either attaching the sampler to the subject's belt using a belt clip on the sampler; or, by providing the individual with a special pouch-belt combination designed to hold the sampler and adjust to the subject's waist size. With the sampler attached to the subject's waist, the length of tubing which connects the media to the sampler inlet was run up the subject's back and over his/her shoulder where the manifold and/or collection media was affixed to the individual's lapel or shirt so as to place the inlet in his breathing zone. With the sample data recorded and the sampler in place the subject proceeded with his daily work routine. The process of recording the necessary data from the subject and fitting him with a sampler required roughly five minutes per subject. The work activities of the individuals were observed at various times during any given shift and recorded in the time log section of the Data Sheet. Field blanks were collected during the course of each sampled shift for submittal

along with the sampling media for analysis. In this later case, area exhaust samples were collected. This implies simply that the sampler was set in a secured area where sampling was to be performed rather than being worn by an individual. Such samples represent the contaminant concentration within a given area rather than the level of exposure for any particular individual.

At the completion of the shift, samplers were collected, turned off and the stop times recorded on the data sheets. The sample media was removed from the low flow manifold or tygon tubing and caps placed on the open ends. A subset of study participants were asked a series of three questions which were designed to identify any unusual events which may have occurred during the sampled shift. No unusual events were described, however, respondents did characterize their activity levels for the shifts during which air samples were obtained. The activity levels for 41% of the shifts were described "low compared to other days", 56% were reportedly "average compared to other days" and 3% were "high compared to other days".

At the end of the sampled shift, all samplers were post-calibrated in the same manner as they were calibrated prior to the shift. The pre- and post- shift calibration values were then compared and averaged to yield a mean flow rate over the course of

the entire sampled period. A difference of greater than ten percent between pre- and post-shift calibration values resulted in the voiding of that sample.

Following collection of all shift samples and post-calibration of all samplers, the data sheets were checked for completeness and the samplers returned to the charging station for use on the next sampling excursion. The collected sampling media was placed in storage bags and kept in a secure, cool and shaded area.

Following collection of samples at each base location, the charcoal tube sampling media were sent to Armstrong Laboratory at Brooks AFB in San Antonio, Texas for analysis. The teflon filters were returned to the University of Cincinnati for analysis. Prior to sending the samples for analysis at Armstrong Laboratory, information required by the laboratory was transferred from the data sheets to Air Force Form 2750 (see Appendix E). This form summarizes only the data required for sample analysis such as flow rates, analytes and sample volumes.

Laboratory analyses of the charcoal tubes were performed in accordance with NIOSH recommended analytical methods 1550, 1501 and 1500 for naphthas, benzene, toluene, heptane and xylenes. Analysis of the teflon filters was done in accordance with NIOSH's recommended analytical method #0500 for gravimetric analysis and

according to a method for nitro-PAH analysis developed by Dr. Glenn Talaska, University of Cincinnati CIH Biomonitoring Laboratory. Upon receipt of the analytical results, the values were entered into a computer database for report generation and statistical analysis.

3. Statistical Analysis of Sampling Results

Upon receipt of all analytical results, and their entry into a database format, the complete database was readied for statistical analysis using Statistical Analyzing System (SAS). The unburned and burned jet fuel exposure concentrations were entered into separate databases and considered individually. However, in both cases, the database was created using Microsoft Excel, a program which allows for the easy formatting and sorting of data.

4. Postural Sway Study

A parallel neurological investigation was conducted at two base locations, AF Bases A and C. This pilot study was conducted by Air Force Institute of Technology sponsored master's graduate student Major Leslie Smith under Dr. Amit Bhattacharya, Biomechanics - Ergonomics Research Laboratory in the Department of Environmental Health. He and Dr. Bhattacharya investigated the effects of chronic exposure to jet fuels upon the central nervous system as measured by one's ability to maintain upright body

balance. For this parallel investigation the same individuals as participated in the breathing zone sampling were recruited for postural sway testing.

The method used to quantify the effect of cumulative jet fuel exposure on a worker's postural balance is a microprocessor-based force platform technique which can non-invasively measure human body sway.[28,29]

a. Subjects

Individuals selected for the postural sway study were a subgroup of the exposure study pool of 63. The balance study subjects were limited to USAF employees working in the JP-8 fuel related occupations for at least six months. The selected work areas included Jet Engine Repair, Jet Engine Test Cell, C-5 Aircraft Fuels Maintenance, and Base Fuels Distribution Center which were reported as having potential jet fuel exposure. Sample size estimates of 30 exposed subjects were defined to measure an effect size of 0.25 with 80% power and alpha = 0.05 as defined in Dick et al.,[28] a study of postural sway testing protocol for neuro-behavioral toxicology.

The 30 recruited volunteers met the eligibility requirements from the pool of 63. This group had a mean exposure period of 12 years, range 0.8 to 30 years, working in jet fuels related

occupations. Thirty-seven percent of the exposure group had worked only with JP-8. Racial composition of the exposed volunteers consisted of 12 Caucasian, 10 Hispanic, and 5 African American subjects. The final analysis group, however, comprised 27 subjects, 20 women and 7 men, with a mean age 37.5,(range 23.6 to 57.4). Three subjects were excluded because two failed to complete the assessment and one had a disqualifying neurological disorder.

A group of 25 unexposed subjects with comparable age to the exposed group was used for postural sway comparison. This group consisted of volunteers from military, university and other sources. The group had a mean age of 34.0 years, range 21.0 to 57.0 and gender mix of 14 male subjects and 11 female subjects. Racial composition of the unexposed volunteers was 16 Caucasian, 7 Asian and 2 African American subjects.

Each subject's physical measurements for weight, height, foot length and width were collected at the time of testing. Subjects also completed health and work history questionnaires. The health questionnaire identified age, sex, race, use of alcohol, caffeine, smoking, medication and health histories used to identify factors which may influence postural balance. The work history questionnaire was used to determine the duration of time working with JP-8 and the total years of contact with all jet fuels. This

questionnaire also identified other solvent exposure from hobbies, second jobs or previous occupations.

b. Exposure Models

Three separate exposure variables were used during analysis. These are identified as: (a) "TWA-acute" the acute exposure based on 8-hour time weighted average air samples for each subject, (b) "Cum JP-8" and (c) "Cum All-JP". Exposure variables (b) and (c) are calculations of cumulative exposure derived from estimating average daily 8-hour samples taken on each subject and multiplying by individual duration data provided in the work history questionnaires. "Cum JP-8" is the current level times the duration during which the subjects worked with JP-8 jet fuel. This period is the most recent exposure work period for all exposure subjects. "Cum All-JP" is total jet fuel exposure and includes the total duration of exposure to all jet fuels the subjects encountered during their USAF careers multiplied by the current levels of exposure. Each analyte was assessed separately for each exposure period. To clarify identification of specific analysis the results are addressed by exposure period then analytes; for example, "Cum JP-8 Benzene" is analysis of exposure during the JP-8 work period for cumulative benzene.

In summary, calculations of cumulative exposure combined

individual exposure TWAs multiplied by a years worked factor. The years worked factor was determined by using actual years worked multiplied by a generic "work-year hours". Work-year hours is defined as normal annual work period, in units of hours, for USAF maintenance workers subtracting time for normal leave, sick leave and federal holidays. The years worked factor was used for JP-8 work period (CumJP-8) and total jet fuel work period (Cum All-JP).

c. Postural Sway Assessment

Postural sway measurements were conducted with an Advanced Mechanical Technology, Inc (AMTI) "AccuSway System" portable measurement platform and a Halikan Chaplet System, NBD 486 laptop computer. This force platform is equipped with "Hall Effect" sensors with built-in microprocessor to capture signals of forces and moments then transfer them directly to the microcomputer via an RS-232 serial port. The platform provides direct outputs for force in the vertical direction (Fz), horizontal directions (Fx and Fy), and moment around the x-axis (lateral), moment around the y-axis (anterior-posterior) and moment around the vertical z axis[30]. Data are acquired at 50Hz sampling rate and is transmitted through the RS-232 interface at 9600 baud. The data was analyzed with the Body Balance Software developed by the University of Cincinnati(All rights reserved 1995). This software calculates the x-y

coordinates of body center of pressure for each 30 second test. Area and length are used to characterize the sway patterns obtained in this study. Total area of sway (SA) is the area enclosed within the envelope of the outer perimeter of the x-y plot of the center of pressure. Total length of sway (SL) is determined by the distance in centimeters traversed by the center of pressure during the test period.

Postural sway testing method followed the approved protocol established in University of Cincinnati Institutional Review Board Protocol. The technique used to measure postural sway quantifies movement patterns of the body's center of pressure associated with body sway as an indirect assessment of central nervous system effect. The test measures proprioceptive, visual, and vestibular systems associated with body balance. As postural control systems are compromised, changes in sway pattern can be quantified through mapping of increased postural sway. To accurately measure postural sway, all subjects performed a series of four separate 30 second postural sway tests which is then repeated in reverse order. Each test was developed to task separate portions or combinations thereof in the subjects postural control systems (Appendix F). Specifically, the Four tests are as follows:

TEST	PROTOCOL	PRIMARY AFFERENT SYSTEMS TESTED
EO	eyes open, standing on bare force platform	Visual, Proprioceptive, Vestibular
EC	eyes closed, standing on bare force platform	Proprioceptive, Vestibular (removes the visual system)
FO	eyes open, standing on 4 inch foam covered force platform	Visual, Vestibular (destablizes the proprioceptive system)
FC	eyes closed, standing on 4 inch foam covered force platform	Vestibular (removes visual and destablizes the proprioceptive system)

Dr. Bhattacharya's group has performed research on the neurological effects of solvents using postural balance testing methods for the past ten years. The technique has been tested and validated and found to be sufficiently sensitive to detect significant changes in body balance with a reference solvent (ethanol) level as low as 0.02% blood alcohol level[30]. Published research includes using this method as a tool to measure increase in postural sway in children correlated with increased blood lead levels[31], in a study of pesticide applicators which noted a significant increase in proprioceptive impairment[32], and in a study of benzene exposure to sewer workers[33].

The results of this pilot study were presented at national industrial hygiene[34] and toxicology[35] conferences simultaneous to the publication of the National Research Council study on the

toxicological effects of military fuels[2]. One of the recommendations of the NRC report was to conduct further quantitative research on the neurological effects of aviation fuels.

B. Results

1. Description of Subjects

A total of 63 subjects employed in job zones associated with historically elevated levels of jet fuel exposure were recruited to wear personal air sampling equipment at bases A, B and C. An additional employee was approached about the study, but declined participation. Females with potential exposure were preferentially recruited in accordance with a predetermined selection algorithm (see Appendix G). However, when women were not available for recruitment in a zone associated with historically high exposure levels, men were recruited. Application of this selection strategy resulted in the recruitment of six women and ten men at Base A, sixteen women and thirteen men at Base B and one woman and seventeen men at Base C. The median age of both female and male participants was 32 years. Females ranged in age from 21 to 51 years while male's ages ranged from 19 to 62 years.

2. Technical Objective 1

The first objective was addressed using USAF personnel record summary data procured from the Military Personnel Center at Randolph AFB[36,37] and cross-referenced with exposure levels documented during the feasibility investigation. As an initial step, jobs (AFSCs and OSs) were sorted and ranked by the level of exposure to benzene and naphthas recorded during IH sampling. Tables 1 and 2 present the number of air samples, mean levels, ranges and standard deviations in mg/m^3 for naphthas and benzene listed in descending order by the average analyte levels for each sampled AFSC/OS. The number of air samples representing each AFSC/OS ranged from one to seventeen for both naphthas and benzene.

Next, USAF personnel data[36,37] were used to rank USAF bases located in the U.S. according to the number of women in jobs associated with the ten highest mean jet fuel analyte, i.e., benzene and naphthas, levels as identified in Tables 1 and 2. Table 3 displays the estimated number of exposed females in the seven bases identified, by the above criteria, as potentially having the most women in jobs with naphthas and benzene exposure. The base rankings and corresponding cumulative totals of exposed women, as presented in Table 3, were compared to the sample size requirement estimates for specific reproductive outcomes described

in Table 4[38]. This comparison permitted a determination of the number of bases needed to analyze each reproductive outcome and, more specifically, the best candidate base sites for a follow-up study. As noted in Table 3, the selection of Tinker, McClellan, Kelly and Robins AFBs permitted the potential recruitment of approximately 158 women employed in AFSC/OS associated with the highest mean naphthas levels and an overlapping group of 107 women working in the AFSC/OS with the most elevated mean exposures to benzene. Assuming an 80% participation rate, 126 women with potentially high levels of naphthas would be recruited for study. **With reference to Table 4 (below), inclusion of these four AFBs permits detection of a 20% effect size for each of the selected urinary endocrine biomarkers and menstrual outcomes at $\alpha=0.05$ with the exception of the percentage of cycles without an LH surge and $E_1$3G peak. The estimated study size will be adequate for the detection of a 30% effect size for all of the outcome measurements described in TABLE 4.**

Table 1

Benzene Levels (mg/m^3) Obtained for Reported AFSC's/OS's Ranked by Mean Values: Number of Personal Air Samples, Means, Ranges and Standard Deviations

AFSC/OS	# of Air Samples	Mean (mg/m^3)	Range (mg/m^3)	Standard Deviation mg/m^3)
2A654	1	0.148	NA	NA
2F051	1	0.109	NA	NA
8852	9	0.049	(0.008-0.102)	0.048
8268	16	0.045	(0.006-0.211)	0.067
5413	17	0.030	(0.008-0.092)	0.033
2F031	3	0.022	(0.007-0.050)	0.025
2W151	4	0.019	(0.006-0.056)	0.025
2892	1	0.011	NA	NA
2A6X4*	2	0.009	(0.008-0.009)	0.001
2A332B	2	0.008	(0.008-0.008)	0.000
8602	1	0.008	NA	NA
2A67A1	2	0.008	(0.008-0.008)	0.000
2A651A	7	0.008	(0.007-0.008)	0.001
2A636	2	0.008	(0.007-0.008)	0.001
2A6X1A*	8	0.007	(0.007-0.008)	0.001
2A634	8	0.007	(0.006-0.009)	0.001
3806	8	0.007	(0.006-0.008)	0.001

* skill level not reported

Table 2

Naphtha Levels (mg/m^3) Obtained for Reported AFSC's/OS's Ranked by Mean Values: Number of Personal Air Samples, Means, Ranges and Standard Deviations

AFSC/OS	# of Air Samples	Mean (mg/m^3)	Range (mg/m^3)	Standard Deviation (mg/m^3)
8268	16	15.475	(2.170-36.500)	11.647
2F051	1	11.100	NA	NA
2892	1	10.200	NA	NA
A2654	1	8.240	NA	NA
2F031	3	5.121	(0.402-11.300)	5.594
8852	9	4.839	(0.407-18.200)	5.481
3806	8	3.804	(0.970-10.000)	3.209
2A634	8	2.689	(0.358-17.500)	6.004
5413	17	2.343	(0.407-9.420)	2.694
2A6X4*	2	1.881	(0.472-3.290)	1.993
2W151	4	1.872	(0.329-5.690)	2.572
2A332B	2	1.745	(1.720-1.770)	0.035
2A651A	7	0.880	(0.346-2.160)	0.723
2A67A1	2	0.543	(0.426-0.660)	0.165
2A6X1A*	8	0.527	(0.339-0.860)	0.239
8602	1	0.426	NA	NA
2A636	2	0.373	(0.351-0.394)	0.030

*skill level not reported

Table 3

U.S.A.F. Bases Having the Highest Number of Women Occupying AFSC's/OS's (Job Codes) with Probable Exposure to Benzene and Naptha

Benzene		Naphtha	
USAF Base	Number of Females	USAF Base	Number of Females
Edwards	11	Edwards	11
Hill	18	Hill	26
Kelly	29	Kelly	34
McClellan	30	McClellan	43
Robins	18	Robins	35
Tinker	30	Tinker	46
Travis	14	Travis	12
	----		----
TOTAL	150	TOTAL	207

TABLE 4: SAMPLE SIZE NEEDED FOR THREE EFFECT SIZE CALCULATIONS FOR SELECTED URINARY ENDOCRINE BIOMARKERS AND ASSOCIATED PARAMETERS. (LH=LUTEINIZING HORMONE, $E_1$3G=ESTRONE-3-GLUCURONIDE, PD3G-PREGNANEDIOL-3-GLUCURONIDE). KESNER ET AL. (1992)

			Number of Women Needed in Exposed and Unexposed Groups		
Parameter	Mean	SE	20% Effect Size[a]	25% Effect Size	30% Effect Size
Cycle Length (d)	30.1	2.43	26	17	12
Follicular phase (d)	18.2	3.00	83	55	39
Luteal phase (d)	13.1	0.55	7	4	3
LH surge					
Day of onset	18.2	3.00	83	55	39
Peak (mIU · mg^{-1} creatinine)	101.8	15.10	68	45	31
% cycles without surge	80.0	0.13	104	67	47
$E_1$3G					
Day of peak	18.7	3.03	80	54	37
Peak (μg · mg^{-1} creatinine)	77.0	16.27	136	91	63
Pd3G					
Day of peak	27.2	3.20	43	28	20
Peak (μ · mg^{-1} creatinine)	6.2	1.06	92	60	41
Surge to peak (d)	9.0	0.63	16	10	7
$E_1$3G : Pd3G					
Day of peak	16.3	3.13	84	56	39
Value of peak	63.1	6.16	23	15	10
Urine					
LH	10.0	1.58	97	63	44
Pd3G	0.9	0.11	65	38	26

[a] Number of subjects required per group to detect a 20%, 25% and 30% effect at
α=0.05 and β=0.20.
(d)=days

3. Technical Objective 2

To fulfill objective two, measurements of jet fuel exposures were obtained using the previously described IH sampling measures. Historical IH jet fuel exposure data were also obtained for the base/zone selection process. Analysis of the newly collected exposure data yielded low exposure concentrations. These results shall be considered, firstly, by individual base location, secondly as a grouped collection of all bases and, finally, in comparison to historical sampling data. Exposure concentrations within a base sampled population shall first be described as their own entities and then compared against exposure concentrations observed at the other two bases. The results from all three base locations are described as a group with attention paid to trends within this collection of sampling data. Finally, the historical sampling data base is described and compared against the database comprised of all newly collected sampling data provided by the USAF.

Many of the unburned jet fuel exposure concentrations were reported as less than the limit of detection. In order to include these data in the statistical analysis process, all levels below the limit of detection were converted to numerical values by dividing these by the square root of two as recommended by Hornung and Reed[39].

All exposure data were entered into SAS and analyzed for simple statistics such as means, standard deviations, minimums and maximums as well as more elaborate comparative tests such as correlations and t-tests. In a similar manner the newly collected data was compared against the historical exposure data.

The statistical analysis procedures produced large amounts of data in the ASCII(DOS) format. These data were imported into Microsoft Excel to produce tables, graphs and charts.

a. Summary of Operations At Collection Sites

Air Force Base A:

Base A's primary mission is to flight test and evaluate improvements and new systems on modern aircraft. The base employs roughly 725 officers, 3820 enlisted and 9,080 civilian persons. It also houses some 121 aircraft and uses JP-8 as its sole jet fuel.

Formal computerized historical exposure records were not maintained at Base A; therefore, the pre-selection of potential sampling areas was performed using qualitative exposure records provided by the base Bioenvironmental Engineering Flight. These records presented exposures by AFSC/OS on the basis of the presence or absence of the potential for chemical exposure, as well as suspected frequencies of exposures where these existed. Using this available information, a list of potentially exposed AFSC/OSs was compiled which contained those areas of the base where daily

exposures to jet fuel were anticipated (see Appendix H1).

Samples were collected at base A during the two week period of September 10 and 17, 1995. The primary point of contact on base was a Technical Sergeant in the base's BEE shop. With the help of this contact and others, seven shops were identified as sampling sites: 3804 Test Cell, 3800 TF33/J85 section, 3810 JEIM, 3810 7100 Section, 3800 Accessories Lab, 412 CRS Fuel Systems and 95 Supply/LGCFD. From these sampling locations, sixteen individuals were recruited for participation in the study. Of the sixteen, six participants were female. The samples collected at base A were analyzed for benzene, naphthas, toluene and m-, o- and p-xylenes. Naphthas was reported by Armstrong Laboratory as reflecting total exposure concentrations for JP-8 and jet fuel in general. A total listing of all sampling results for Base A can be found in Appendix I.

The primary analytes of interest are naphthas and benzene. Naphthas are important as a reflection of total JP-8 exposure. Benzene is of interest as JP-8 was introduced in order to minimize, or eliminate, benzene exposure from jet fuel, a problem that had been associated with JP-4, the predecessor to JP-8. The highest naphthas exposure concentration found at base A was 2.5 parts per million(ppm). This concentration is associated with the AFSC/OS 2F031 in the Fuel Supply Shop. The highest benzene exposure reported was associated with the same sample at a level of 0.02

ppm. The exposure concentrations in ppm associated with all samples collected at Base A are summarized in the following table. Mean female exposures were slightly lower than mean male exposure concentrations within any given analyte class. However, the sample size at Base A was not adequate to the test statistical significance of these differences.

Table 5: Mean Exposure Concentrations - Base A

Analyte	Overall Mean(n+)	Female Mean(n+)	Male Mean(n+)	ACGIH TWA-TLV
naphthas	0.36(26)	0.35(10)	0.37(16)	300
benzene	<0.01(26)	<0.01(10)	<0.01(16)	10,a2*
heptane	<0.01(26)	<0.01(10)	<0.01(16)	400
m-xylene	0.01(26)	0.01(10)	0.01(16)	100
o-xylene	<0.01(26)	<0.01(10)	<0.01(16)	100
p-xylene	<0.01(26)	<0.01(10)	0.01(16)	100
toluene	0.01(26)	<0.01(10)	0.01(16)	50

(Mean exposure concentrations, ppm, by analyte)

* class A2 carcinogen

+ n=number of air samples

Air Force Base B:

Base B is the primary maintenance and repair facility for the Minuteman and Peacekeeper missiles as well as the F-4, F-16 and C-130 aircraft. The base employs approximately five thousand hourly

civilian employees and five thousand active duty military workers. Approximately forty-seven percent of the work force is under the age of forty and over ninety percent are male and Caucasian. Base B was the last domestic USAF base to switch from JP-4 to JP-8. At the time of air sampling for current exposure concentrations, only JP-4 was in use.

Using the historical exposure data provided by Base B, nine priority zones were identified as potential areas of elevated exposure (see Appendix H2). Samples were collected in two separate rounds at Base B. The first round of sample collection was conducted during the week of July 9, 1995 and identified six sampling areas: 421FS APG, 225 Sheetmetal, 225 F-16 Fuels, 388 MS Fuels Shop, 225 C-130 Fuels and Petroleum Flight 914. During this initial round of sampling, six individuals were sampled for exposure to unburned jet fuel, all of whom were female. A second round of sampling was performed two months later at Base B over a two week period from September 6 to 20, 1995. The second round of sampling focused on the same basic sampling areas but a different set of individuals. Round two sampling for unburned jet fuel, JP-4, was conducted on a group of fifteen individuals of which five were female. The results of all air sampling are summarized in Table 5 and the complete listing of results can be found in Appendix I.

Table 6: Mean Exposure Concentrations - Base B

Analyte	Overall Mean(n+)	Female Mean(n+)	Male Mean(n+)	ACGIH TWA-TLV
naphthas	1.83(40)	2.49(20)	1.18(20)	300
benzene	0.01(40)	0.02(20)**	<0.01(20)	10,a2*
m-xylene	0.04(40)	0.06(20)**	0.01(20)	100
o-xylene	0.02(40)	0.04(20)	<0.01(20)	100
p-xylene	0.02(40)	0.04(20)	<0.01(20)	100
toluene	0.06(40)	0.11(20)	0.01(20)	50

(Mean exposure concentrations, ppm, by analyte)

* class A2 carcinogen

** significantly higher than males ($p<0.05$)

+ n = number of air samples

The sampling results at this base revealed female mean exposure levels to be greater than those for males in all analyte categories. This difference between gender means is most pronounced for the analytes benzene and m-xylene. In the instances of these two analytes, the difference between female and male mean exposure concentrations were found to be statistically significant at the 95% confidence level using a paired t test.

Air Force Base C:

Base C is part of a network in air force materiel command responsible for acquisition, supply, maintenance and distribution activities. Base C manages aircraft, engines stock items, weapons, maintenance, transportation and other services worldwide. The base

currently handles over fifty percent of the Air Force's engines at the 4,660 acre 592 building facility. The base employs a total of nearly 26,000 persons of whom nearly 16,000 are civilian. Base C utilizes a combination of JP-8 and JP-5 fuels, with different fuels being used at different areas of the base. The two fuels are quite similar with JP-5 having a slightly higher flash point than JP-8 (see Appendix J).

The historical exposure data reported by Base C resulted in the identification of five priority zones. Based on the walk-through evaluation, six additional zones of suspected daily fuel exposure were identified (see Appendix H3). Samples were collected at this location during the weeks of September 25 and October 1, 1995. With the base contact's input, four of the eleven preliminarily identified zones were selected and sampled: 094A C-5 Flight Prep, 042D Test Cell, 041A Test Cell and 203A Base Fuels. From these four areas, seventeen individuals participated in the collection of air samples. The population composed of all four sampling areas contained only one female worker. This single female was recruited for participation in the study. The exposure concentration results are summarized in Table 7 and the complete listing of exposure concentrations can be found in Appendix I.

Naphthas exposure concentrations at Base C ranged to a maximum of 4.04 ppm while benzene exposure showed a maximum of 0.03 ppm.

Since only one female was sampled, no inferences can be made.

Table 7: Mean Exposure Concentrations - Base C

Analyte	Overall Mean(n*)	Female Mean(n*)	Male Mean(n*)	ACGIH TWA-TLV
naphthas	0.66(21)	1.09(2)	0.61(19)	300
benzene	0.01(21)	<0.01(2)	0.01(19)	10,a2
heptane	0.01(21)	<0.01(2)	0.01(19)	400
m-xylene	0.01(21)	<0.01(2)	0.01(19)	100
o-xylene	<0.01(21)	<0.01(2)	<0.01(19)	100
p-xylene	<0.01(21)	<0.01(2)	<0.01(19)	100
toluene	0.01(21)	0.01(2)	0.01(19)	50

(Mean exposure concentrations, ppm, by analyte)

*n = number of air samples

b. Intra-base Comparisons

The mean exposure values for each analyte at the three bases can be compared across bases. Total mean exposure values (for both males and females) were compared from base to base using an analysis of variance (ANOVA) procedure and t test. The results of this procedure are summarized in Table 8. The test results indicated statistically significant differences in mean exposure concentrations between bases for the analytes benzene, naphthas and m-xylene. Table 8 illustrates a significant association among naphthas exposure concentrations and base. Statistically significant differences (alpha=0.05) in mean benzene exposure

levels were demonstrated at Base B were found to be higher than those noted at Base A. The mean benzene exposure concentrations for all bases by gender are illustrated in Figure 1.

The naphthas and m-xylene mean exposure levels for the sampled population at Base B were found to be higher than those observed at either Base A or Base C. The differences were again statistically significant at the 95% confidence level. The difference in mean naphtha levels across all bases visited by gender are illustrated in Figure 2.

c. Overall Exposure Trends

Next, exposure values for all three bases were combined into a single "Current Fuels Exposure" database. Following the compilation of these data, statistics were calculated for this larger assemblage of these data. The mean exposures were calculated by analyte irrespective of gender, and analyte by job code (AFSC/OS). The results of these calculation are illustrated in Figures 3 and, by gender, in Figure 4.

Table 8

Paired T Tests Results

Comparison of Mean Exposure Concentrations by Analyte and Base

(Alpha=0.05, Confidence=0.95)

Analyte	Base Comparison	Lower Confidence Limit (PPM)	Difference Between Means (PPM)	Upper Confidence Limit (PPM)	Statistically Significant @ the 0.05 Level
Naphthas	Base B - Base C	0.340	1.178	2.012	YES
	Base B - Base A	0.694	1.473	2.253	YES
	Base A - Base C	-1.204	0.296	0.613	
Benzene	Base B - Base C	-0.002	0.004	0.010	
	Base B - Base A	0.001	0.006	0.012	YES
	Base A - Base C	-0.009	0.003	0.004	
Toluene	Base B - Base C	-0.033	0.050	0.134	
	Base B - Base A	-0.023	0.054	0.132	
	Base A - Base C	-0.095	0.004	0.087	
mXylene	Base B - Base C	-0.003	0.028	0.059	
	Base B - Base A	0.001	0.030	0.058	YES
	Base A - Base C	-0.035	0.002	0.032	
oXylene	Base B - Base C	-0.004	0.017	0.038	
	Base B - Base A	-0.002	0.017	0.037	
	Base A - Base C	-0.024	0.001	0.022	
pXylene	Base B - Base A	-0.003	0.016	0.034	
	Base B - Base C	-0.002	0.018	0.037	
	Base C - Base A	-0.023	0.002	0.019	

Note: This test controls for the type I comparisonwise error rate not the experimentwise error rate.

Table 9

Comparison of Mean Exposure Concentrations by Analyte and Gender

(Alpha=0.05, Confidence=0.95)

			T Test (means comparison)			
Analyte	df	Comparison Criteria	Lower Confidence Limit(PPM)	Difference Between Means(PPM)	Upper Confidence Limit(PPM)	Stat. Sig @ Alpha 0.05
Naphthas	92	Female - Male	0.252	0.952	1.653	Yes
Benzene	92	Female - Male	-0.001	0.004	0.010	
Heptane	52	Female - Male	-0.001	0.009	0.018	
Toluene	92	Female - Male	-0.008	0.057	0.122	
m-Xylene	92	Female - Male	0.008	0.032	0.057	Yes
o-Xylene	92	Female - Male	0.001	0.018	0.035	Yes
p-Xylene	92	Female - Male	0.003	0.018	0.034	Yes

Figure 1:

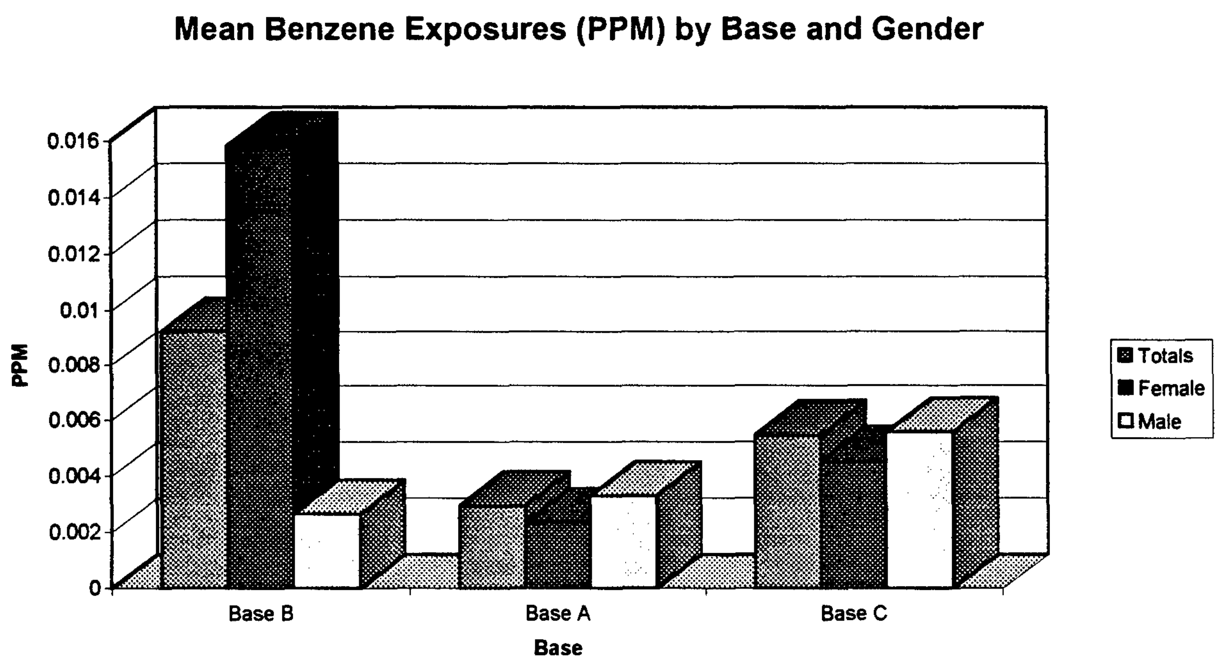


Figure 2:

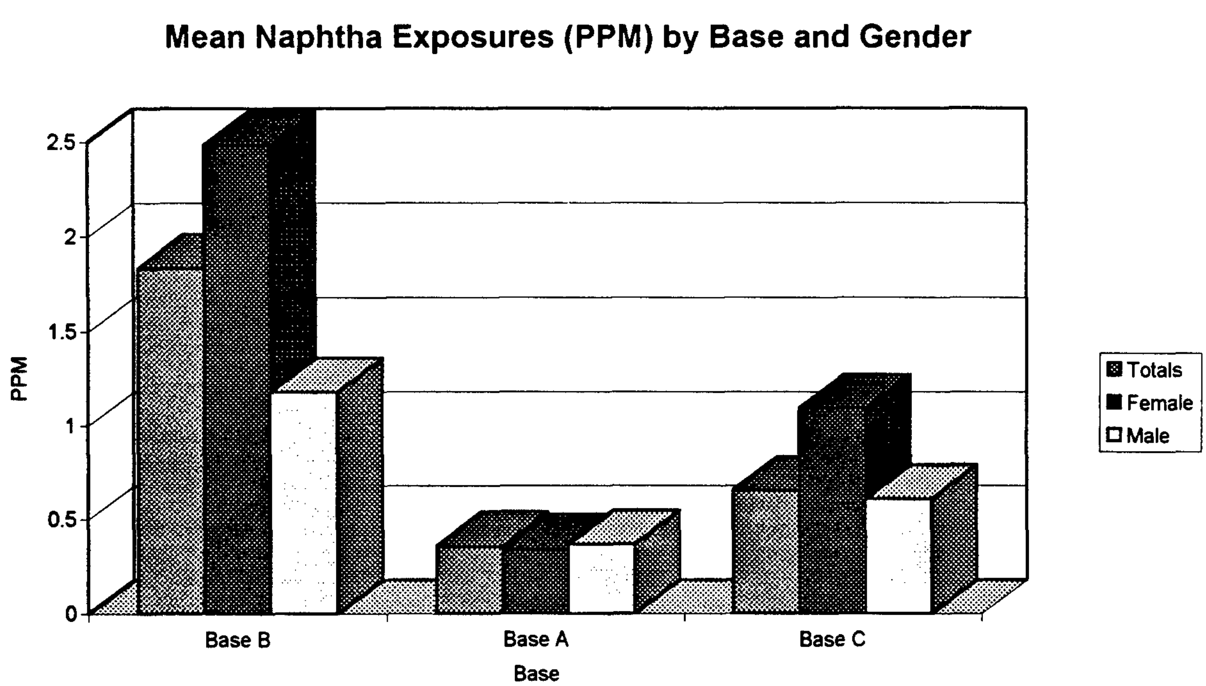


Figure 4 illustrates that, across all bases, mean female exposure levels appear to be greater than mean male exposure levels for all analytes. However, the overall means for women were inflated, in large part, by gender differences in exposure levels at Base B. Base C also contributed to the higher female means for naphtha. Similarly, elevations in women's exposures at these bases contributed to the results of the t-test which revealed statistically significant differences in mean exposure concentrations between men and women (see Table 9). These differences were noted when the analytes benzene, naphthas and m-, o- and p-xylenes were examined. **In summary, analyses indicated that gender has a statistically significant influence on exposure concentration for all analytes except heptane. The analyses also indicate that AFSC/OS has a significant affect when considering naphthas exposure concentrations. Overall exposure trends were examined and are illustrated in Figure 5. An examination of Figure 5 quickly identifies those AFSC/OS's which tend to have elevated exposure concentrations. The AFSC/OS's associated with the highest mean exposure concentrations include 2A654 and 8268 which are both Fuel System Mechanic designations.**

Figure 3

Mean Exposure Concentrations (PPM) by Analyte

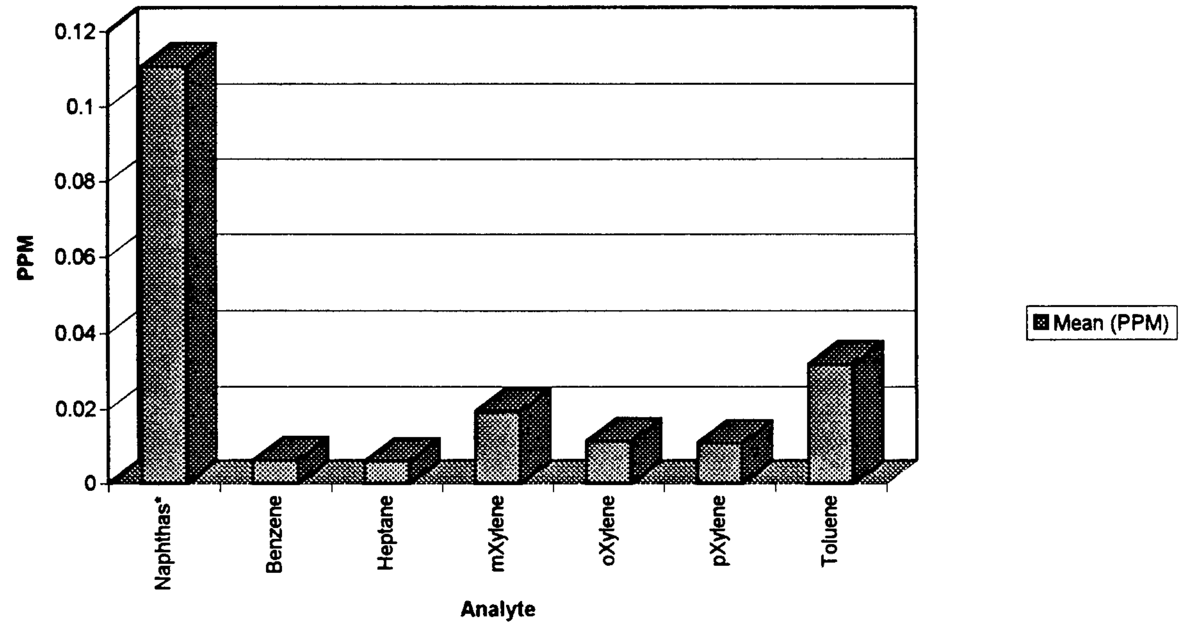
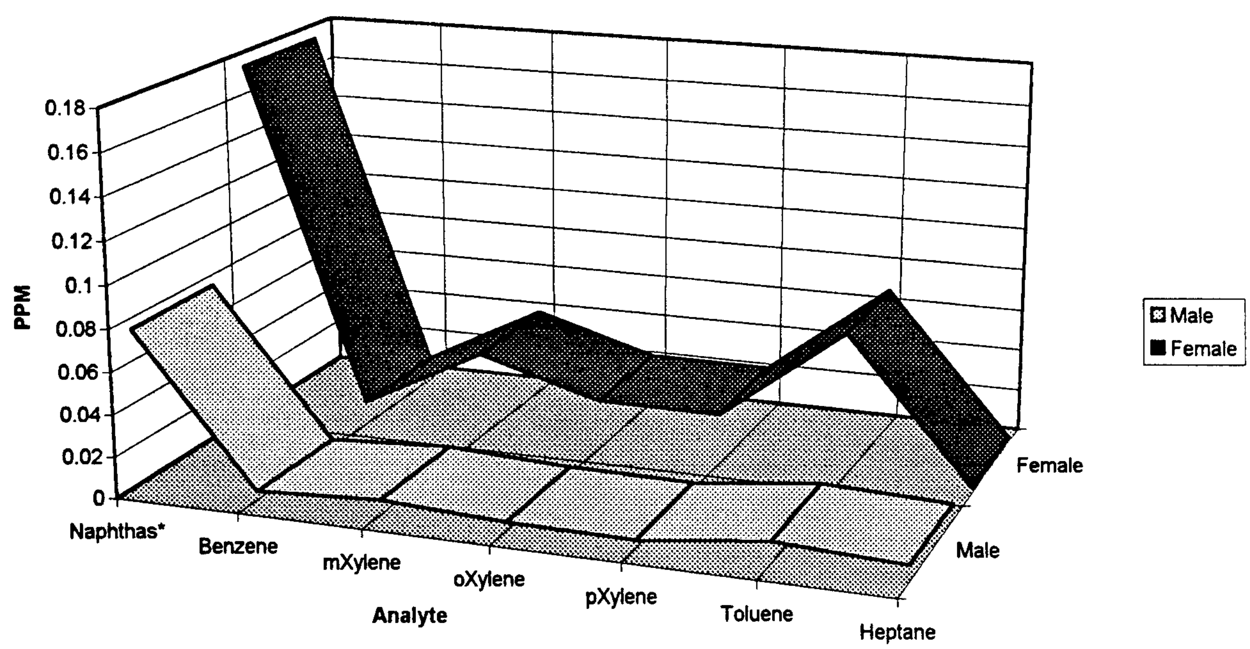


Figure 4

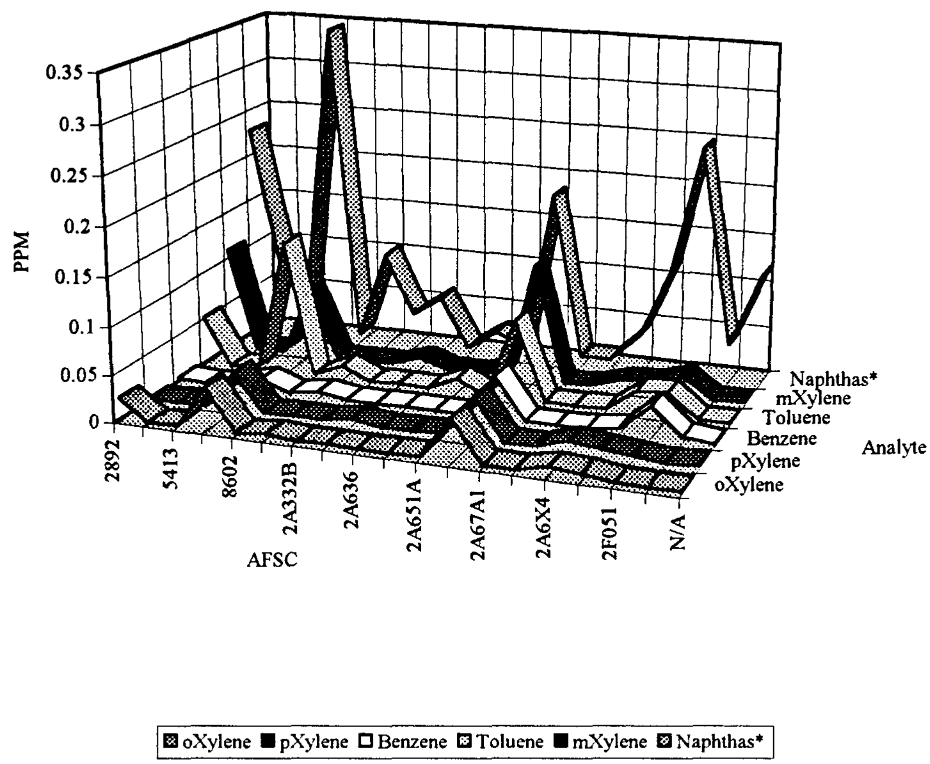
Mean Exposure Concentrations (PPM) by Analyte and Gender



* Means have been divided by 10

Figure 5

Mean Exposure Concentrations (PPM) by AFSC and Analyte



*Mean Naphtha Exposure Concentrations have been divided by ten.

4. Historical Data

The historical database is comprised of quantitative exposure data received from five USAF bases: Base B, Base C, Base D, Base E and Base F. The mean exposure concentrations in ppm for each AF base and analyte are presented in Table 10.

Table 10: Mean Exposure Concentrations - Historical Data

Base	Analyte	Number of Samples	Mean exposure	ACGIH TWA-TLV
Base B	benzene	352	0.12	10,a2
Base B	JP-4(naphthas)	262	5.98	300
Base C	benzene	55	0.15	10,a2
Base C	JP-4(naphthas)	39	3.06	300
Base D	benzene	120	0.23	10,a2
Base D	JP-4(naphthas)	110	6.05	300
Base E	benzene	87	0.12	10,a2
Base E	JP-4/5(naphthas)	59	2.90	300
Base F*	benzene	9	0.03	10,a2
Base F	JP-4(naphthas)	6	1.55	300

(mean exposure concentrations, ppm, by analyte)

The complete assemblage of data compromising the historical data base is found in Appendix K.

a. Historical vs Current Exposure Data Comparison

In order to compare the current exposure concentrations data to the historical data, both sets were divided into three common categories. Fuels Handling, Aircraft Maintenance and Flightline positions (Tables 11 & 12). There was an unusable category necessary in order to deal with the historical data which were for relevant non-fuels related areas that had no comparable group in the newly collected data set. The allocation of exposure data to these groups was accomplished by manually investigating the activities performed in the areas where samples had been collected or reported. The categorized list was reviewed independently for correctness by USAF personnel Colonel John Joyce and Major Leslie Smith for expert validation. With the two data sets divided into corresponding exposure groups and verified, the unusable group was purged from the historical database and a direct comparison of exposure concentrations by analyte was performed using SAS.

It is of interest to note that the Aircraft Maintenance activities had the highest mean jet fuel/naphthas exposure concentrations for both historical and current exposure concentrations. For mean benzene exposure concentrations, the highest values were found again in the Aircraft Maintenance positions for the current exposure concentrations; but in the Fuels Handling positions for the historical data.

Table 11

Data Summary - Historical Exposure Concentrations

			TWA (PPM)			
Analyte	Job Category	N	Minimum	Maximum	Mean	S.D.
Benzene	Fuels Handling	48	0.001	13.215	0.722	2.654
Benzene	Aircraft Maintenance	430	<0.001	3.979	0.177	0.438
Benzene	Flightline Positions	70	<0.001	1.365	0.119	0.240
Jet Fuels/Naphthas	Fuels Handling	42	0.002	7.160	1.898	1.838
Jet Fuels/Naphthas	Aircraft Maintenance	327	0.001	585.931	9.030	39.773
Jet Fuels/Naphthas	Flightline Positions	66	0.001	142.538	8.118	19.845

Table 12

Data Summary - Current Exposure Concentrations

			TWA (PPM)			
Analyte	Job Category	N	Minimum	Maximum	Mean	S.D.
Benzene	Fuels Handling	16	0.002	0.034	0.006	0.008
Benzene	Aircraft Maintenance	63	0.002	0.066	0.007	0.014
Benzene	Flightline Positions	8	0.002	0.018	0.004	0.005
Jet Fuels/Naphthas	Fuels Handling	16	0.089	2.512	0.607	0.901
Jet Fuels/Naphthas	Aircraft Maintenance	63	0.075	8.113	1.335	1.947
Jet Fuels/Naphthas	Flightline Positions	8	0.073	1.265	0.326	0.403

Table 13

Comparisons of Trends

Historical Exposure Concentrations versus Current Exposure Concentrations

(Alpha=0.05, Confidence=0.95)

Benzene

Job Category	df	Comparison Criteria	T Test (means comparison): Lower Confidence Limit(PPM)	Difference Between Means(PPM)	Upper Confidence Limit(PPM)	Stat. Sig @ Alpha =0.05
Fuels Handling	62	Historical - Current	-0.617	0.716	2.049	
Aircraft Maintenance	491	Historical - Current	0.062	0.170	0.279	Yes
Fightline Positions	76	Historical - Current	-0.055	0.115	0.285	

Jet Fuels/Naphthas

Job Category	df	Comparison Criteria	T Test (means comparison): Lower Confidence Limit(PPM)	Difference Between Means(PPM)	Upper Confidence Limit(PPM)	Stat. Sig @ Alpha =0.05
Fuels Handling	56	Historical - Current	0.326	1.291	2.257	Yes
Aircraft Maintenance	388	Historical - Current	-2.169	7.695	17.560	
Fightline Positions	72	Historical - Current	-6.279	7.793	21.865	

Note: The T Test controls the type I comparisonwise error rate not the experimentwise error rate

Descriptive statistics then were calculated for each group under the newly assigned headings using a paired t test. The results of these tests showed statistically significant differences between mean historical and current exposure concentrations for the job categories of Fuels Handling and Aircraft Maintenance (Table 13). The fuels handling category had higher historical mean exposure values for jet fuels/naphthas than do the current exposure values while the aircraft maintenance division had higher historical mean exposure concentrations for benzene exposures.

5. Nitro-PAH Analyses

Nitro polycyclic aromatic hydrocarbons are an important group of environmental and occupational pollutants formed during incomplete combustion. These compounds have been shown to be extremely mutagenic[40]. High levels are seen in diesel engine exhaust, associated with the particulate phase. We hypothesized that jet engine exhaust contains significant, measurable quantities of these highly mutagenic materials. To detect their presence in the breathing zone of exposed workers we have adapted a method utilized by Gupta et al.[27] which exposes lymphocytes from a sensitive donor to extracts made of the material collected from a worker's breathing zone. DNA is isolated from the lymphocytes and carcinogen-DNA adduct analysis is performed using ^{32}P-postlabelling. The distinctive adduct patterns caused by the nitro-PAH compounds

would indicate their presence in the extracts; presence in positive extracts would be confirmed by mass spectroscopic analysis.

Rationale for the Assay and Preliminary Studies to Determine Appropriate Donors: Due to the expense of analyzing for nitro PAH in air samples (estimated at $1000. per sample), it was decided to take a staged approach and screen the air samples using a biological assay potentially sensitive for the presence of these compounds. The assay selected involves using human peripheral blood leukocytes exposed *in vitro* to compounds. Gupta, et al.[27] (1988) reported that these cells can be very sensitive to nitro PAH, forming high levels of specific DNA adducts when incubated *in vitro* with these compounds. The basis of this sensitivity for nitro PAH is the ability of these cells to reduce the nitro PAH to a reactive *N*-hydroxy compound; these have been shown to bind to DNA human leukocytes and human bladder urethelium. Assuming positive findings for stage one, then extracts from samples were to be sent to an analytical laboratory which would perform GC-MS analysis of the compounds to confirm the presence of nitro PAH. This approach was discussed with several experts in the carcinogen biomonitoring field including Drs. Fred Kadlubar and Fred Beland of the National Center for Toxicological Research. There was general agreement that this would be an excellent approach to this problem.

A series of methods development experiments were performed in

September and October of 1995 to perfect the technique for cell isolation and treatment. 1-Nitropyrene (mw = 238) was obtained from Dr. Frederick Beland of the National Center for Toxicological Research. This material was used as the positive standard for these studies. Dr. Beland provided documentation that the material was 99+% pure. The material was solubilized in DMSO and dilutions were made to a working stock of 620 ng/μl. When 300 μl of this solution was used in a 5 ml culture, the final concentration was 37.2 μg/ml (0.156 μMol/ml) of cell suspension.

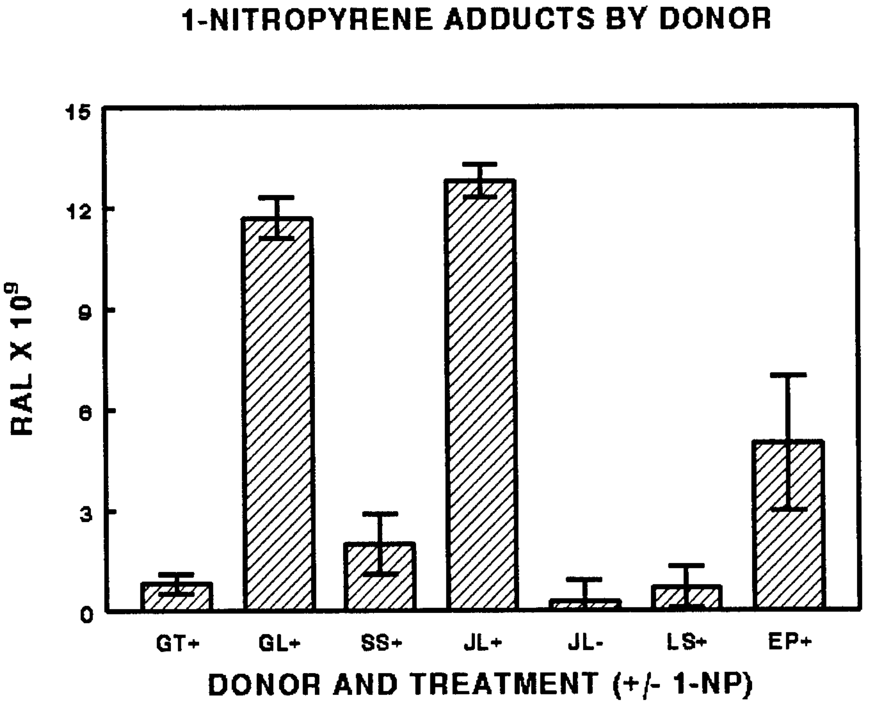
Gupta et al. reported a 10-fold variability in the response of two donors in the activation of 1-nitropyrene and its subsequent DNA binding. Because of this reported variability, preliminary studies were undertaken to identify individuals whose PBL were able to readily reduce nitro PAH and form DNA adducts. For these studies 30 ml of blood was drawn from 6 volunteers and, after isolation, their cells were treated *in vitro* to 1-nitropyrene. Cells were recovered and DNA was isolated as described below. DNA was hydrolyzed and ^{32}P-postlabelled as described below. Cells from 2 donors (JL and GL) were clearly more responsive to 1-nitropyrene than the other samples. Each of these samples was 5 times as responsive as the next best sample from another donor (Figure 6). These responsive donors were then asked to provide blood samples for the cells for all subsequent analyses.

Using these blood samples a series of ^{32}P-postlabelling assays were performed. All samples were coded to blind the analyst to their identity. No DNA adducts were seen in any sample. These findings are consistent with the low level of total particulate noted in the samples. .002, .003, .005, .005, .006, .007, .007, .008, .009, .011, .012, .013, .015, .015, .015, .015, .016, .017, .019, .021, .022, .023, .024, .024, .027, .028, .028, .033, .033, .045.

Several samples, e.g., .015, were repeated multiple times to determine if run-to-run variability was responsible for the apparent inability to detect adducts. In addition, positive and negative controls were included in each run. In addition a separate ^{32}P-postlabelling assay was run using the nuclease P_1 technique for increasing sensitivity. Regardless, no adducts were seen.

To summarize, a new method to use cultured human lymphocytes to monitor exposure to nitroaromatic compounds using air samples taken from the breathing zone of workers was developed in the Biomonitoring Lab. Samples from several University of Cincinnati donors were analyzed to determine the best responders and these persons then provided blood samples for the rest of the studies.

Figure 6


1-NITROPYRENE ADDUCTS BY DONOR
15
12
9
6
3
0
RAL X 10^9
GT+
GL+
SS+
JL+
JL-
LS+
EP+
DONOR AND TREATMENT (+/- 1-NP)

Extracts from thirty one samples were then analyzed along with positive and negative controls. No DNA adducts were detected in any extract of an air sample with the conclusion that this technique was not sufficiently sensitive to detect very low particulate levels. Appendix L is the Collection and Analysis protocol.

6. Postural Sway Analyses

As previously described, this collateral investigation addressed chronic low level JP-8 jet fuel exposure in a healthy workforce to determine if a cumulative effect was evident through postural balance measurements.

All analysis used the mean total area of sway and total length of sway for each test from the two sway balance trials conducted by the subjects. Analysis of Variance (ANOVA) and Student's T-test were used to compare the sway variables of the exposure group to the control group. Bivariate correlation was used to identify confounders and covariates of significant association. Linear multiple regression analysis using a backward elimination of covariates was used to determine the relationship between jet fuel exposure and postural sway.

The Statistical Analysis System (SAS) software package[26] used for data analysis included the following procedures: Proc Reg - for stepwise backward elimination used on exposure group for comparison

of sway to exposure and cofactors; Proc GLM for ANOVA comparison of groups sway parameters and Proc T-TEST to compare group demographics; and Proc Corr for calculation of Pearson correlation coefficient to confirm potential confounders and covariates.

The regression model's backward elimination method systematically eliminates the worst fit variables until all remaining variables have a p-value of less than 0.1. The exposure variable was forced to remain in the model regardless of p-value. Covariates which remained after backward elimination are identified as cofactors of the regression model. Since only one direction (increased sway) was deemed significant in the regression models, a one-tail alpha of 0.05 was used for statistical inference. The initial linear regression models for total area of sway and total length of sway were:

Natural log of dependent sway variable =

b0 + b1(solvent exposure) + b2 (gender)

+b3 (WTHT) + b4 (age) + b5 (alcohol)

+b6 (caffeine) + b7 (smoking)

where independent variables b0-b7 are the regression coefficients. Only final models with variables having p-values ≤ 0.05 are considered significant.

A Student's T-test for statistical comparison between the time a subject was tested and results of the subject's balance test was

conducted to identify any influence on sway results caused by acute exposure during the test day. Subjects were assigned a score by sub-set: (0) for those tested during the first four hours of the work period and (1) for those tested in the last four hours of the work shift.

a. Results

This collateral investigation examined chronic low level JP-8 jet fuel exposure in a healthy workforce to determine if a cumulative effect on central nervous system (CNS) function was evident. Postural balance measurements were conducted as non-invasive, sensitive indicators of subtle CNS effects. As previously described, 27 participants from the exposure study were also recruited for inclusion in the exposed group for this study. The comparison group consisted of 25 unexposed personnel from military, university and other sources.

Demographic characteristics of the exposed and unexposed groups are compared in Table 14 below:

Table 14: Demographics Comparison

Variable	EXPOSURE GROUP N=27 Mean (Std Dev)	CONTROL GROUP N=25 Mean (Std Dev)
AGE	37.49 (9.29)	34.01 (8.32)
HEIGHT	171.52 (7.37)	169.29 (8.69)
WEIGHT	79.64 (18.57)	70.46 (13.17)
WTHT RATIO	0.46 (0.10)	0.42 (0.07)
SMOKE	6.41 (8.66)	1.40 (3.92)
ALCOHOL	9.28 (18.38)	0.95 (1.21)
CAFF	3.30 (2.60)	2.12 (2.01)

The specific aims of the study were (a) to determine if there were postural balance differences existed between a JP-8 exposed and a non-exposed population and (b) to determine if there is a relationship between chronic exposure to jet fuel constituents and changes in postural sway.

Test - retest: The Spearman test-retest correlation coefficients for sway test pairs was conducted (SAS program Proc Corr). Correlation results were 0.88 for sway length and 0.73 for sway area. This demonstrates good reproducibility of measured sway variables and is consistent with studies by Bhattacharya[29-31], Kuo[33], and Sack[32].

Table 15

Mean Exposure Summary by Job and Analyte in PPM

Reported in parts per million (ppm)

		Benzene			Toluene			m,o,p-Xylene			Naphthas		
Job	No.	TWA	JP-8	All-JP	TWA	JP-8	All-JP	TWA	JP-8	All-JP	TWA	JP-8	All-JP
ACGIH TLV*		10			50			100			300		
Test Cell	6	0.002	3.73	5.65	0.002	3.05	4.68	0.003	4.32	7.03	0.14	197.4	306.7
Jet Eng. Mech	5	0.003	2.56	4.08	0.005	4.07	5.35	0.002	2.30	3.41	0.36	611.0	675.7
C-5Fuels	7	0.009	2.34	34.30	0.023	6.66	46.01	0.015	5.65	38.98	1.06	299.2	2243.4
Fuels	9	0.008	9.35	30.83	0.007	8.87	29.41	0.009	9.57	31.11	0.49	555.1	1599.0
Total	27	0.006	5.03	21.18	0.010	6.11	23.76	0.008	6.04	22.67	0.54	419.6	1307.9

* American Conference of Governmental Industrial Hygienist (ACGIH) Recommended 8 hour Exposure Threshold Limit Values (1996).

TWA = 8-hour TWA - acute exposure work period

JP-8 = Cumulative JP-8 jet fuel exposure work period

All-JP = Cumulative exposure work period for all types of jet fuel

Industrial Hygiene Sampling: Exposure Group mean 8-hour TWA exposure concentrations were: naphthas 0.54ppm, benzene 0.006ppm, toluene 0.01ppm and m,o,p-xylene 0.008ppm. Table 15 provides average exposure data for each analyte in acute jet fuel (TWA-acute), JP-8 (CumJP-8) and total jet fuel (Cum All-JP) exposure periods. Of note is how similar the mean naphthas exposure is between the Jet Engine Mechanics (0.36 ppm) and Fuels Distribution subjects (0.49 ppm). There was a statistically significant difference, however, between the two groups in mean solvent exposures, such as benzene levels where Jet Engine Mechanics averaged 0.003 ppm and Fuels Distribution were 0.008 ppm. A comparison of matched subjects from these two groups is used in the stabilograph example to highlight the significance of the solvent difference.

b. Postural Sway Findings

Comparison of exposed group to a non-exposed group was conducted (specific aim one). Results of a one-tail T-test for comparison of mean log postural total sway area (SA) with age forced into the comparison, was marginally significant (p=0.06) for the Eyes Open (EO) test while standing on bare platform. The EO test measured the collective effects of the visual, pro-prioceptive and vestibular systems controlling postural sway. Exposed workers had a 40% increased mean log postural sway area and a 2% decrease in

area of sway length (SL) as compared with the non-exposed population. The sway results from the remaining three test conditions were not significant.

Postural balance analysis of the exposure group was conducted to identify differences in sway data and exposure levels of jet fuel constituents (specific aim two). This analysis included regression modeling identify associations between dependent and independent variables and bivariate correlation to identify covariates and confounders.

Evaluation of association between the exposed group's postural sway and the effect of each analyte at the different exposure periods was conducted through use of regression analysis using backward elimination method. **The regression models identified a statistically significant association ($p<0.05$) between the solvents benzene, toluene and m,o,p xylene and increased postural sway.** The best regression model was the cumulative benzene exposure during the JP-8 work period model (CumJP-8 Benzene). Table 16 lists the Cum JP-8 Benzene model by test condition. The table includes significant variables, coefficients, p-values and coefficient of determination (r^2). This model shows a statistically significant association ($p<0.05$) between CumJP-8 Benzene levels and sway levels (SL) for all test conditions. Model data includes an exposure coefficient range of

Table 16

Regression Analysis of Cumulative Benzene Exposure During the JP-8 Work Period and Postural Sway Test Results

Exposure: JP-8 Benzene (N=27)

Test	Outcome Variable	Indepen. Variable	Parameter Estimate	Std. Error	(one tail) P-value	Model R^2
EO	Lt Area	Intercept	0.78	0.13		0.08
		Exposure	0.02	0.01	0.08	
	Lt Ltg	Intercept	4.35	0.15		0.56
		Exposure	0.01	<0.01	0.01	
		WTHT	-1.43	0.31	<0.001	
EC	Lt Area	Intercept	1.05	0.10		0.19
		Exposure	0.03	0.01	0.01	
	Lt Ltg	Intercept	3.95	0.09		0.44
		Exposure	0.02	0.01	<0.001	
		Gender	-0.17	0.09	0.03	
		Caffeine	0.03	0.02	0.04	
FO	Lt Area	Intercept	2.01	0.39		0.22
		Exposure	0.01	0.01	0.13	
		WTHT	-1.80	0.81	0.02	
	Lt Ltg	Intercept	4.31	0.15		0.64
		Exposure	0.01	<0.01	<0.01	
		Age	0.01	<0.01	<0.01	
		WTHT	-1.55	0.29	<0.001	
FC	Lt Area	Intercept	1.72	0.10		0.08
		Exposure	0.02	0.01	0.08	
	Lt Ltg	Intercept	4.39	0.22		0.52
		Exposure	0.01	0.01	<0.01	
		Age	0.01	<0.01	<0.01	
		WTHT	-1.35	0.42	<0.01	

EO = eyes open, standing on bare force platform.
EC = eyes closed, standing on bare force platform.
FO = eyes open, standing on 4 inch foam covered force platform.
FC = eyes closed, standing on 4 inch foam covered force platform.
Lt Area = log of area; Lt Ltg = log of length;
Exposure = Cumulative benzene exposure during the JP-8 work period.

0.01 to 0.03, r^2 range of 0.44 to 0.64 and a statistical significant p-value range of 0.0005 to 0.01 for all sway tests.

Age demonstrated a non-zero bivariate correlation ($p<0.1$) with both the exposure and sway variables in the vestibular system only (FC) test for the total jet fuel exposure period (Cum All-JP); no additional confounders were identified. Height, Weight, WTHT, Caffeine as were identified as covariates where (a) Height, Weight, and WTHT ratio were significantly associated with the visual/proprioceptive/vestibular (EO) and visual/vestibular (FO) system tests and (b) caffeine was associated with proprioceptive/ vestibular (EC) and vestibular alone (FC) system tests.

Cofactors identified in the regression modeling included: (a) WTHT which has a significant association with most test conditions, (b) gender and caffeine for the cumulative benzene exposure during the JP-8 work period (CumJP-8 Benzene) EC test for area of sway length (SL) only, and (c) age for most FO tests and all cumulative for JP-8 work period (CumJP-8) solvent exposure FC tests. Consistently through the regression models the WTHT cofactor was negative while all other coefficients were positive. Smoking was never associated with sway at $p < 0.05$.

No significant difference in postural sway area and length was noted between the subjects tested early during the work day and those subjects tested late. This is an important note to eliminate

any possibility of acute effects from work occurring during the test day on the sway analysis.

C. Discussion

1. Feasibility Study of Fuel Exposure to Women

One of the most prevalent exposures at all Air Force (AF) bases is to jet fuel. Total consumption ranks in the billions of gallons. As of October 1995 there were approximately 52,000 active enlisted women in the Air Force. Ninety-six percent of these women are under the age of 40 and in their prime reproductive years. Among the four Armed Services, the Air; Force has the second highest proportion of female active duty personnel (34%) and is opening Air Force aircraft assignments, including combat missions, to qualified women[41]. Fuel exposure is probably the greatest single occupational hazard in terms of volume used of any in the armed forces, and of many civilian work sites. Jet fuel is composed of aliphatic and aromatic hydrocarbons that have been related to adverse reproductive health effects including menstrual disorders, infertility and fetal effects. Little attention has been given to the potential reproductive health effects to young women of chronic, low-level jet fuel exposure.

Therefore, this study was conducted by University of Cincinnati and USAF investigators to determine the feasibility of a prospective investigation of female AF military and civilian personnel for

potential adverse reproductive health effects associated with jet fuel exposure. Toward this end, two technical objectives were addressed: 1) the number of female AF personnel was evaluated and it was found that an adequate sample size for the measurement of menstrual and hormonal outcomes in the proposed prospective study could be achieved by the inclusion of four to six bases. Specifically, McClellan, Tinker, Kelly, Robins, Hill, Travis and Edward AFBs will be sought for inclusion. Concomitantly, it was noted that a large number of jobs across many other USAF bases are held by women who have almost daily contact with fuels; and 2) current exposures to jet fuel analytes, including benzene, were characterized as low dose.

With regard to the sampling data collected during the course of this study, all values fell below the American Conference of Governmental Industrial Hygienist (ACGIH) Time Weighted Average (TWA) Threshold Limit Values (TLVs) for benzene, naphthas, heptane, toluene and xylene; 10 ppm, 300 ppm, 400 ppm, 50 ppm and 100 ppm, respectively. Exposure limits for benzene carry an A2 carcinogen classification which identify it as a suspect human carcinogen. The OSHA PEL for benzene is set at a level lower than the TLV, 1 ppm. In the 1995-1996 ACGIH TLV Handbook, Benzene is found in the table of intended changes. The TLV for benzene is intended to go to 0.3 ppm with an A1 classification which identifies the chemical as a

confirmed human carcinogen.

Quite a few of the analytical results were found to be below the limit of detection. These low exposure concentrations may be due in part to the performance of many of the jobs out of doors. The large dilution factor presented by open air work at the bases visited, particularly at Kelly AFB, may serve those particular workers well, but may not be representative of other workers doing similar jobs in an enclosed facility, such as a hanger. Another factor which may have contributed to the overall low exposures observed is the work level encountered during sampling. On several occasions study participants and their managers expressed regrets that the study had not been conducted during a time of higher activity. This trend held true through both the fuels handling and maintenance operations. According to participants' reports, 39% of samples were taken during shifts with comparatively low work activity. At Base A, the maintenance manager relayed that the study's sampling period fell at one of the times of lowest activity in the year, mid-summer. The maintenance manager informed the researchers that the best time to investigate jet fuel exposure from engine work is shortly after seasonal changes due to the higher volume of work. The reason for this being that the temperature changes cause the aircraft engines to operate at less than peak performance and the engines are, therefore, sent in for service.

This influx of engines for service results in a much higher level of work activity than that observed during sampling for this investigation. The fuel distribution workers expressed similar sentiment stating that their level of work can be much higher than that observed during the sampling periods due to flight and readiness exercises which result in higher levels of flightline activity.

For these reasons, the sampling results obtained during this investigation, although accurate, may reflect the low end of the exposure spectrum. Should this be the case, high end exposures remain undocumented and need to be investigated if the effects of this type of exposure are to be further addressed.

The availability of historical data incorporated an interesting facet into the sampling area identification process. In most instances the list generated using the previously mentioned algorithm identified areas of historically elevated exposures which did not necessarily correspond to areas of current elevated exposures. On several occasions, the areas identified using the historical data no longer existed or had undergone a mission or process change which left an unsuitable sampling location. However, the lists generated using the historical data did provide starting points for investigation of potential sampling sites and of discussion with knowledgeable persons at each base.

At each base visited, the help of the bioenvironmental engineers (BEEs) shop was invaluable. Individuals from these shops are responsible for the routine sampling, oversight and tracking of occupational exposures in the base shops and their activities. This knowledge, and their willingness to share it, were key in the gathering of base and sampling data.

Of the sixty-four total persons approached for recruitment into the study, only one declined to participate. Nearly all participants expressed sincere interest not only in participating in the study, but in discussing their jobs, exposure scenarios and potential exposure outcomes. All study participants expressed a desire to be informed as to the sampling outcomes and were more than willing to volunteer the information necessary for completion of the study. In many cases, an individual recruited into the study was able to suggest others who were similarly exposed and would be interested in participating. Several participants were even able to point out other areas of the base to investigate as potential sampling sites. The study participants were a valuable asset in completion of the investigation; for their time as well as their input.

Further, this investigation revealed that female military personnel are concerned about their reproductive health consequences of exposure to jet fuel. Statements such as "If I was to become

pregnant what are the possible effects of past exposure" and "I'm concerned about working inside fuel tanks and having fuel get on clothing and bringing vapors" were voiced by the participants. In fact, of the 18 female participants having jet fuel exposure, 61% of the women expressed health concerns. The third and very important finding was that Base commanders are very concerned about this issue and we had some bases requesting to be included in the study.

Although no differences in work practices were noted between the male and female study participants, mean exposures for naphtha, benzene and xylenes were higher among female AF personnel than among men. This significant finding ($\alpha=0.05$) was driven in large part by the high proportion of women from the Base B in our cohort. Base C also contributed to the elevation of naphtha in women, however. When exposure levels were examined across gender, Base B had significantly higher mean benzene and m-xylene than base A and significantly higher naphtha levels than either Bases A or C. Still, women at Base B had significantly higher levels of exposure ($\alpha=0.05$) than men at the same base. Variations in work type and schedules at Base B may potentially have contributed to exposure dissimilarities as men and women were sampled on different dates. The sample sizes of women at Bases A and C were too small to test within-base gender differences in analyte levels, but levels appeared for males and females fairly comparable. Therefore, further

exploration of this finding is warranted.

There are several explanations for the trend of higher benzene and naphtha exposures at Base B described above. The most obvious explanation is related to the types of fuels used at the bases. Base B was the only, of the three bases investigated, to use JP-4. JP-4 possesses properties which differ from JP-6 and JP-5, the fuels used at Base A and Base C. JP-4 is more volatile than are either JP-8 or JP-5. This higher level of volatility would doubtlessly lead to higher observed exposure levels. A second potential explanation has to do with the level of familiarity at each base. At Base B the primary point of contact was a University of Cincinnati field researcher who has worked at that site for several years. This investigator's higher level of familiarity with study design and interest in the study objectives may have allowed her to identify a more highly exposed group of individuals than was accomplished at other bases. That is not to say that the point of contact at other bases did not attempt to find the highest exposures, rather that time limitations and the need to focus their efforts in other areas, would not allow these other base contacts to investigate the areas of potential exposure as completely as may have been accomplished at Base B.

The AFSC/OS's associated with the highest mean exposure concentrations include 2A654 and 8268 which are both Fuel System

Mechanic designations. In addition, newly collected exposure concentrations were significantly. different from mean historical levels within the Fuels Handling and Aircraft Maintenance job categories. Specifically, the Fuels handling category exhibited higher historical mean exposure values for jet fuels/naphthas than did the current exposure values while the Aircraft Maintenance Division demonstrated higher historical exposure concentrations from benzene exposures. Aircraft Maintenance activities demonstrate the highest mean jet fuel/naphthas exposure concentrations for both historical and current exposure concentrations. For mean benzene exposure concentrations, the highest values were found again in the Aircraft Maintenance positions for the current exposure concentrations; but in the Fuels Handling positions for the historical data.

The decrease noted for mean benzene exposure concentrations in the newly collected data in the aircraft maintenance areas is consistent with what would be expected following the change in fuels from JP-4 to JP-8. The decreased benzene content in JP-8, compared to the levels common in JP-4, would result in lowered benzene exposure concentrations from this source. This decrease coupled with the general move away tram benzene containing products likely accounts for the noted decrease in mean benzene exposure concentrations.

The statistically significant decrease in mean jet fuels/naphthas exposure concentrations noted for the fuels handling category is interesting because the same decline was not observed in benzene exposure concentrations. Although a decline in mean benzene exposure concentrations was noted, it was not found to be statistically significant.

This trend may be explained by observing the work practices of fuel handlers in general. The decrease in jet fuels/naphthas concentrations can be explained by the change in primary jet fuels from JP-4 to JP-8. Since the majority of fuels handlers spend their days transporting fuels, the decreased volatility of JP-8, in comparison to JP-4, along with improved work practices and equipment would doubtlessly account for the observed decrease in mean jet fuels/naphthas exposure concentration. The lack of a corresponding decrease in mean benzene concentrations is likely due to the variety of fuels with which the fuel handlers interact. If jet fuel were the only source of potential benzene exposure one would expect a decrease in mean benzene exposure concentrations to accompany the reduction in jet fuels/naphthas concentrations. Since this was found not to be the case, one can suggest that jet fuel is not the only source of benzene. The variety of fuels handled including diesel, unleaded and specialty fuels, provide potential point sources which could prevent the decrease in benzene exposure

concentration that would be expected were jet fuel the only source.

The lack of any notable decline in average exposure concentration in the flightline positions is not unexpected. Individuals working on the flightline are exposed to a broad range of potential exposures ranging from jet fuels, gasolines and hydraulic fluids to exhausts, cleaning solvents and oils. With this wide range of potential exposures, it is not surprising that substitution in one area does not result in a notable reduction in overall mean exposure concentrations.

Finally, observed higher mean exposure concentrations in the aircraft maintenance occupations is consistent with the type of work these individuals undertake. Many of the maintenance activities involve working in close proximity to fuel systems and open fuel tanks. During several maintenance operations workers must physically enter fuel tanks which, although purged, often contain residual fuels. The potential for exposure under these scenarios is confounded when one considers the enormous scale of many of the modern aircraft.

2. Postural Sway

This corollary study demonstrated a positive association between an increase in exposure level and an increase in postural sway implying poor postural balance. An overview of the regression models implicates Cum JP-8 Benzene, i.e., cumulative benzene

exposure during the JP-8 work period, as the most significant exposure variable affecting postural balance. Of the two dependent variables, sway and sway length, regression models for sway length had more significant results ($p \leq 0.05$) and much higher coefficients of determination (r^2). Sway length for cumulative JP-8 Benzene were statistically significant in all four tests and the cumulative JP-8 xylene the models were significant in three of the four tests. A review of exposure models of SL for the three exposure variables: acute, cumulative JP-8, and cumulative jet fuel petroleum indicates that the cumulative JP-8 exposure model showed the most statistically significant results.

Analysis of the exposure models implicates potential functional impairment of postural balance from cumulative exposure to low levels of solvents. The most significant effect was seen in the cumulative JP-8 Benzene exposure period regression model (Table 16). This model had the highest r^2 values in the FO (0.64) and EC (0.44) tests for SL. **Increases in sway measured in these tests implies that functional abilities of proprioceptive and vestibular pathways are possibly affected.[29,31,42]** This result is consistent with the findings of the Kuo W, et al.[33] study of industrial waste workers which noted a positive correlation between postural sway and organic solvent exposure for the more difficult tests EC, FO and FC.

Xylene and toluene regression models of SL were also

statistically significant for cumulative periods, but not for acute TWA periods. The xylene models were similar to the benzene models and had the most statistically significant effect in the Cum JP-8 period for EO test and FC test of SL, with only FC statistically significant in the Cum All-JP period. However, unlike benzene, xylene model was not statistically significant in the TWA-acute period for any tests. The lack of an acute effect is consistent with the findings of the Savolainen, et al [43] study where subjects exposed to 100-400ppm m-xylene for four hours found no statistically significant increase in postural sway. The difference in outcome of the solvent models to exposure time periods and strength of correlation may implicate factors such as long term degradation of neurological systems similar to what is seen with solvents and hearing loss.[44] **The outcome of these models does support the theory of a cumulative effect from low doses of neurological toxicants as opposed to an acute effect.[3,45,46]**

This outcome becomes more relevant when associated with the findings of Bergin, et al.[47] in a study of body sway and vibration and the Knave, et al.[48] study of jet fuel exposure. The Bergin study used a similar force-plate system and proprioceptive challenge tests for vision (EC, FC) and compliant surface (FO, FC) to measure postural balance and combined this with three different tests for vibration perception. Bergin showed how subjects with a higher

vibration threshold sway more than those with lower thresholds implying potential modification of the peripheral nervous system. This study noted when the proprioceptive system is stressed, small differences in vibration perception threshold in the normal population may become important for postural sway control. The Knave study identified signs and symptoms possibly indicative of polyneuropathy in a population routinely exposed to jet fuel. This finding included identification of an over representation of higher vibration thresholds of the extremities in the exposed group. Our study essentially provides further support to the findings in these studies, but with a shorten exposure period than that observed by Bergin and Knave[47,48]. The most significant correlation between routine low level exposure to jet fuel and increased sway identified in our study is in the tests which challenge the proprioception system (EC,FO). Since the mean age of our study population is considerably younger than the Bergin and Knave subjects, the effect from cumulative exposure appears to manifest earlier than expected. **The immediate implication of these results is that if jet fuel does reduce proprioception functionality then this could be a significant safety factor for personnel working around aircraft in dark areas, on slippery (oil, water, ice) or compliant surfaces (mud, soft soil).** The long term implication of continued routine exposure is potentially an increased risk of degrading some neurological

functions.

The postural balance test provides a good pre-clinical measurement method to identify the on-set of long term CNS degradation as manifested by changes in postural sway. Postural sway testing may be used as a pre-clinical tool to monitor changes in postural balance just as an audiometry program monitors changes in hearing threshold. A system where annual postural sway measurements are compared to a baseline measurement could provide occupational medicine providers with a method of measuring the effects of neurotoxic chemicals on the workforce. There is published work which indicates a need for associating the two types of preventive medicine tools. Findings from the Morata, T., et al.[44,48] study noted a positive association between occupational exposure to solvents and hearing disorders, Odkvist, et al[46] has identified vestibular-ocular motor damage from solvent and jet fuel exposure, and Bergin et al[47]. used an audiometer's bone vibrator to assess proprioceptive function. It is apparent that postural balance measurements may be useful in combination with a hearing conservation program to better quantity the synergistic effects of occupational noise and solvent exposure on an at risk population[28].

In addition to monitoring the postural balance effects of neurotoxic solvents on maintenance workers, the balance test may be useful for monitoring USAF flight crew members. This group has

potential for significant pressure changes associated with high altitude flight, receive routine very low exposure to jet fuels, and must have excellent vestibulo-ocular motor function. Two studies which emphasize the importance of these factors are the Adolfson, et al.[49] study of atmospheric pressure changes on divers which noted an effect on the postural balance portion of the vestibular system. The other is Odkvist, et al.[46] study of solvent effects on the vestibulo-oculomotor system which noted a 50% abnormal response in jet fuel exposed subjects for visual suppression test, tracking of non-periodic targets. **These findings become even more significant when viewed in the context of flying at super-sonic speed where minute degradation to any neural pathway could be catastrophic. The findings also support the use of balance testing as a quantitative measurement during routine medical examination. Medical services supporting flight crews may also find balance testing useful as a tool to measure recovery prior to medically qualifying a pilot to flying status. In situations where a crew member is grounded due to some type of neurological insult, such as acute high exposure to a neurotoxic solvent in which recovery cannot be easily measured through subjective tests[50], the use of a quantitative balance test to compare against a baseline measurement would prove useful for determining recovery.**

In summary, this study showed an increase in postural sway from

relatively low TWA exposure levels over a moderate work period of 5 to 11 years. Mean TWA exposure levels of JP-8 constituents were significantly below ACGIH TLVs and lower than other exposure studies previously mentioned.[3,4,5,50,51] The exposure models indicate that the solvents analyzed here have a significant influence on postural balance of exposed workers. The implication is that routine low level dosees of these neurotoxic solvents has a cumulative effect. This result may provide early indication of potential long term neurological health effects such as those noted in the Scandinavian studies.[3,4,5,51,52]

Nitro-PAH Analysis

Finally, a new method to monitor nitroaromatic compounds collected during study sampling was tested at the University of Cincinnati.

III. Conclusions

Based upon the exposure data collected during this investigation, several conclusions can be drawn. First, adequate statistical power to conduct a follow-up[study of the potential female reproductive effects from exposure to jet fuel is achievable given the future participation of four USAF bases. Specifically, the sample size will be sufficient to investigate two critical female reproductive outcomes, i.e., hormonal changes and menstrual

disorders. Further, based upon the air sampling results, the exposures under investigation will likely be low level, i.e., below current ACGIH TWA-TLVs. The potential for female reproductive system endocrine disruption from exposure to operational levels, i.e., low levels, of jet fuel is unknown. If women are a large and growing portion of the exposed workforce, investigations of outcomes unique to their physiology are indicated. Especially in view of the observation that, under various scenarios at certain bases, their exposures may be slightly higher than those encountered by men. Our results, therefore, support the feasibility of a follow-up study of the reproductive endocrine and menstrual health of women exposed to low doses of jet fuel.

With regard to exposure conditions sampled during the feasibility study, levels did not exceed the ACGIH TWA-TLVs for naphtha, benzene, heptane, toluene or xylenes at the time of sampling. These results can not be generalized to represent exposure levels under all working conditions. The previously noted low level of work activity at the time of sampling make it impossible to extrapolate, from this data, exposures which may occur during moderate to heavy work loads. Additionally, the performance of work activities out-of-doors cannot be assumed to reflect similar work performed indoors.

Statistically significant difference (alpha=0.05) were noted

between current exposure concentrations and those reported in the historical exposure data. Current mean exposure concentrations were found to be less than those observed in the historical data for benzene and jet fuels/naphthas. Current benzene concentrations were significantly lower than historical levels for aircraft maintenance positions while current jet fuels/naphthas exposures were found to be significantly reduced from historical values for fuels handling positions. These differences are generally in line with what would be expected to accompany the switch in primary jet fuels from JP-4 to JP-8. JP-8's decreased volatility, higher flashpoint and lowered benzene content would lead one to expect corresponding exposure concentration reductions in areas where jet fuel is the primary, or only, source of solvent exposure. Further evaluations of this trend at times of high flying or maintenance activity would likely serve to strengthen the validity of this observation.

The results of the parallel postural-sway investigation suggest that chronic, low level exposure to solvents may produce subtle, long term neurological effects. Future in-depth study with increased sample size is needed to better characterize and determine long term health effect implications and intervention ideas.

In summary, this investigation provides a snapshot of what is truly an expansive and complex spectrum of exposure scenarios. The exposure trends and postural sway outcomes identified here should be

further investigated in future studies. The feasibility of a future study of female reproductive outcomes is supported.

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Appendix A

Informed Consent

INFORMED CONSENT

A FEASIBILITY STUDY OF ACTIVE DUTY MILITARY PERSONNEL AND EXPOSURE TO JET FUEL

University of Cincinnati Medical Center
5251 Medical Sciences Building (ML 0182)
PO Box 670182
Cincinnati, Ohio 45267-0182

Principal Investigator: Grace K. Lemasters, PhD

Associates: Lt Col George New, PhD, PE, Hill AFB
Col Richard A. Henderson, III, MD, Wright-Patterson
Lt Col John Joyce, BSc
Glenn Talaska, PhD, CIH
Susan Simpson, MPH

Field Locations: ______, ______, ______ & _____ Air Force Bases

I. INTRODUCTORY PARAGRAPH

Before agreeing to participate in this study, it is important that the following explanation of the proposed procedures be read and understood. It describes the purpose, procedures, benefits, risks, discomforts and precautions of the study. It also describes alternative procedures available and the right to withdraw from the study at any time. It is important to understand that no guarantee or assurance can be made as to the results. It is also understood that refusal to participate in this study will not influence standard treatment for the subject. Your participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation in this study at any time without penalty or loss of benefits to which you are otherwise entitled.

All data and medical information obtained about you as an individual will be considered privileged and held in confidence; you will not be identified in any presentation of the results. Complete confidentiality cannot be promised, particularly to subjects who are military personnel, because information bearing on your health may be required to be reported to appropriate medical or command authorities.

II. I, (please print) ______________________________, agree to participate in a research study, the purpose of which is to determine (1) if there is an adequate number of Air Force personnel exposed to jet fuel to conduct a follow-up study of reproductive risk and (2) to characterize the level of their exposure to jet fuel.

Subject Initials [ ]
Witness Initials [ ]
Today's Date [/ /]

III. PROCEDURES

I understand that I will be asked to wear an air sampling device weighing approximately 10 ounces used to collect samples of air in my work area. The sampling device will be positioned in my work area or worn over my clothing. It will be secured on my side with straps and a collar clip, so as not to interfere with my work, for a full eight hour shift. I will not be requested to perform any additional tasks outside of my regularly assi-gned duties. The equipment will remain in place through all breaks unless I leave the area of exposure. Upon my return it will be reattached. Investigators working with the University of Cincinnati will monitor this sampling procedure. The sampling equipment to be used is not investiga-tional. Sampling will take place at two different time periods lasting three full shifts over two weeks. I will be participating in the protocol for approximately six days. If there is a significant variance from the stated time period, I will be notified. The results of the air samples from my work area will be made available to me.

IV. RISKS AND BENEFITS

I understand there are no known risks associated with wearing this sam-pling device. I also understand that my participation in this study might involve risks which are currently unforeseeable.

I understand that knowledge gained from my participation in this study may benefit myself, my co-workers, my employer and general scientific under-standing of potential exposures by providing information about my w-orkplace.

V. PREGNANCY

If I become pregnant while enrolled in this study, I understand there is no known risk to me or my fetus by participation in this study.

VI. CONFIDENTIALITY OF RECORDS

Data collected regarding my work place exposure will be kept confidential by the University of Cincinnati and remain the sole property of the Uni-versity of Cincinnati. The possibility exists that authorized government agencies, such as the Department of Defense (DOD) and the United States Army Medical Research and Materiel Command (USAMRMC) may review records held by the University of Cincinnati. It is the policy of the USAMRMC that data sheets are to be completed on all volunteers participating in research for entry into this Command's Volunteer Registry Data Base. The information to be entered into this confidential data base includes your name, address, Social Security number, study name and dates. The intent of this data base is two-fold: first, to readily answer questions concerning an individual's participation in research sponsored by USAMRMC; and sec-ond, to ensure that the USAMRMC can exercise its obligation to ensure re-search volunteers are adequately warned (duty to warn) of risks and to

provide new information as it becomes available. The information will be stored at USAMRMC for a minimum of 75 years. When all study information, without individual identities, is analyzed for any abnormal trends, the results of the analysis will be made available to me.

VII. AVAILABILITY OF INFORMATION

A copy of the signed consent form will be provided to me. Any questions that I may have concerning any aspect of this investigation will be answered by Grace Lemasters, Ph.D. (513) 558-0030 (between 0800 and 1630 hours) or (513) 772-9070 (after 1630).

VIII. COMPENSATION

I understand that I am authorized all necessary medical care for injury or illness which is the proximate result of my participation in this research. Contractors must provide such medical care when conducting research on private citizens. Other than medical care that may be provided (and any other remuneration specifically stated in this consent form), there is no other compensation available for my participation in this research study; however, I understand this is not a waiver or release of my legal rights.

The University of Cincinnati Medical Center follows a policy of making all decisions concerning compensation and medical treatment for injuries occurring during or caused by participation in biomedical or behavioral research on an individual basis. If I believe I have been injured as a result of this research, I will contact Grace Lemasters, Ph.D. at (513) 558-0030 (between 0800 and 1630 hours) or (513) 772-9070 (after 1630); or Harry Rudney, Ph.D. at (513) 558-5517.

For Military Subjects: I understand that my entitlement to medical care or compensation in the event of injury are governed by federal laws and regulations, and if I desire further information I may contact Dr. Grace Lemasters, Ph.D. at (513) 558-0030.

IX. FISCAL RESPONSIBILITY

Funds are not available to cover the costs of any ongoing medical care not associated with this research and I remain responsible for the cost of non-research related care. Tests, procedures or other costs incurred solely for purposes of research will not be my financial responsibility. If I have questions about my medical bill relative to research participation, I may contact Grace Lemasters, Ph.D.

Subject Initials [ ]
Witness Initials [ ]
Today's Date [/ /]

X. THE RIGHT TO WITHDRAW

Participation in the study is voluntary. I am free to withdraw from this investigation at any time. Should I wish to withdraw, I have been assured that standard therapy for my condition will remain available to me. I have been informed of the probable consequences of my withdrawal from the study. No penalty or loss of benefits to which I am entitled will result from my refusal to participate or my withdrawal at any time during the study. Questions regarding my rights should be addressed to:

Harry Rudney, Ph.D., Chairperson
Institutional Review Board
125 Wherry Hall, M.L. 0567
University of Cincinnati
PO Box 670567
Cincinnati, Ohio 45267-0567
(513) 558-5517

XI. PARTICIPATION BY ACTIVE DUTY MILITARY PERSONNEL

I am aware that my military duties will take precedence over any obligations I have to the study, and that I may be reassigned to locations where participation is no longer possible. I will inform the Study Coordinator of changes in my duties or duty locations as soon as possible so that my continued participation can be evaluated.

XII. IS THE SUBJECT CURRENTLY PARTICIPATING IN ANOTHER STUDY?

[ ] Yes. If yes, please provide the Principal Investigator's name and title of the study.

[ ] No.

XIII. WITNESSING AND SIGNATURES

____
Subject's Signature   Date

____
Subject's Name (print)

____
Address   City   State   Zip-code

____
Investigator Signature   Date

____
Witness Signature   Date

____
Witness Name (print)

Appendix B

Sampling Protocol

Protocol for Industrial Hygiene Sampling of Persons Potentially Exposed to Burned and Unburned Jet Fuel

I. **Selection of Subjects**

A. Walkthrough Survey by IH Staff: An IH walkthrough will be conducted at the sites by the Study industrial hygienists. During the walkthrough fueling and operating procedures will be reviewed. Selection of subjects for the study will be done on the basis of those who appear to have the highest exposure to either JP-8 or burned JP-8 (exhaust). These will not necessarily be the same men and women. It should be kept in mind that 10 samples will be collected. Five samples will be for JP-8 and 5 for total particulate. As many as 10 different men and women could be sampled if the IH evaluation is that the men and women who have the highest exposure to JP-8 are not the same as those how have the highest exposure to burned JP-8. Another objective of the walkthrough will be the identification of a site to conduct area sampling for total particulate. This site should be located far enough away from any engine to avoid problems with non-isokinetic sampling. The area of highest potential exposure should be identified.

B. Personal Samples: The persons identified as having the highest exposures to either JP-8 and total particulate should be identified and notified that they will be sampled the next day. An informed consent signature indicating the individual's willingness to participate in the study will be obtained.

C. Area Samples: The area selected for area sampling should be secured and demarcated.

II. **Calibration**

A. Equipment: The following equipment will be needed for the sampling. (quantity)

1. Soap bubble calibrator with range of 0.2 to 5 lpm.
2. Personal pumps with a flow rates of 4 lpm. (5)
3. Personal pumps with flowrates of 50-200 ml/min (5)
4. Charcoal tubes for JP-8 sample collections (8). Five are for sampling, 2 are for field blanks and 1 will be labelled and used as a calibration tube. This tube should be identified at random before the initial calibration.
5. Filter cassette blanks (9) and teflon filters (9) with polypropylene web support and pore size of 0.45 μm and support pad for collection of total particulate samples. Five will be used for personal sampling, 1 will be used for area sampling, 2 will serve a field blanks and one will be identified and used as a calibrator for all pumps. The calibration cassette should be identified at random prior to calibration. The filters will be preweighed and coded by the lab prior to use.
6. Tygon tubing (10) 30" length
7. collar clips (10)
8. Battery charger for the above.
9. Extra knit (Air Force Type) belts (5).

B. Calibration Procedure: All pumps will be calibrated prior to and after the sampling. Calibration should be done the morning of the sampling before the work begins. Calibration should be performed in an office away from the work site. Note that the charge condition of the battery packs must be affirmed the night before the sampling.

1. Completely charge battery pack of each pump the night prior to sampling. Check and record the condition of the pumps.

2. Run the pumps for at least 10 minutes prior to calibration. Record the pump model and identifiers. Attach the tygon tubing to the pump and then remove the plugs and attach the calibration cassette checking to see that the filter is correctly placed in the cassette.
3. Prepare the calibrator, wetting the surface of the buret by depressing the button several times. Attach the calibrator to the dedicated calibration cassette and the pump to be calibrated using a short (constant) length of tygon tubing and the appropriate connector.
4. Adjust the nominal flowrate on the pump to 3.5 lpm using a fine screwdriver.
5. Depress the button on the calibrator and note and record the value. Repeat this step 2 additional times. Take the average of the 3 readings. However, each reading should be within 10% of each other. This means that if the highest reading is 3.62 lpm, the lowest acceptable reading would be 3.26 lpm.
6. If the data are acceptable record the mean value, shut off the pump and remove the calibration cassette to the next pump or seal it if all calibrations are complete.
7. Calibration of the low-flow pumps is essentially the same except that the nominal flow should be set to about 0.2 lpm before calibration and that the designated calibration charcoal tube should be used instead of the filter cassette. Again, triplicate values should be obtained for each pump and the individual values must be within 10% of each other.
8. Post-sampling calibration is essentially the same procedure. See Below.
9. If the data are out of range that pump should not be used for sampling until the problem is discovered and corrected. Oft times this is do to incomplete charging.

C. <u>Sampling and Post-Shift Calibration Procedures</u>: Once all pumps have been calibrated they should be packed up and carried to the workfloor.

1. Check that each cassette and charcoal tube is numbered legibly.

2. Prepare the IH sampling data sheets. Assign a cassette and/or a charcoal tube to a particular worker.

3. Affix the pump to the person's belt or ask the worker to wear one of the belts brought for that purpose and affix the pump to this. Behind the hip in the back is often the most comfortable location. Run the tygon tube up over the shoulder using either duct tape or small clamps to fix the tubing to the person's clothing in several places. Affix the cassette or charcoal tube to the collar with the opening facing down. Remove and save all seals and closures. If the same worker will be wearing two pumps for both particulate and JP-8, then place the other pump on the other hip and the tubing to the other lapel. Remove all seals and closures.

4. Start the pumps and record the time to the minute. Ask the worker to state their name. Check the number of the collection media to be certain that the correct media and sample is being worn by the worker.

5. Advise the worker that of how to check that a pump is still running and how

to contact the industrial hygienist in case the pump turns off. Advise them to wear the pump their whole shift and at breaks and lunch if they remain in the work area for these. If the workers leave their work area for lunch, a designated place for the storage of the running pumps must be provided and the workers instructed in how to remove the pumps and place them into the storage space. This space could be nothing more elaborate than a cardboard box. The workers may remove the pump during lunch, but they must be told not to shut the pumps off and be advised where to where to place them. If the workers are not to be wearing the pumps during lunch a place should be provided for temporary storage of the running pumps.

6. The industrial hygienist should remain in the work area(s) observing work practices and making notes of same on each person's IH data sheet.

7. At the end of the sampling period the pumps are turned off (time noted on the IH data sheets to the minute) and removed. Pumps and sampling media should be moved to the office area.

8. Plugs should be replaced in all tubes and secured with tape. Sampling media should be placed in shipping containers consistent with the requirements of the analytical labs. The directions for securing the particulate filters is given below.

9. Pumps should be turned on and the post-shift calibration performed. The average post-shift calibration flow should be within 10% of the pre-shift value. If so, the average of the two values should be reported as the overall flowrate. If the flowrates are not within 10% of each other the sample is voided.

D. <u>Preparation of Filter Cassettes for Shipping</u>

1. Tape plugs in place in the cassettes. Place cassettes in the mailer and be sure that they are addressed to:

Ms. Marlene Jaeger
The Biomonitoring Laboratory
The Department of Environmental Health
The University of Cincinnati Medial School
123 East Shields Street
Cincinnati, OH 45220

III. ANALYTICAL STRATEGY FOR THE TOTAL PARTICULATE AND NITRO-PAH ANALYSIS BY ^{32}P-POSTLABELLING

A. <u>Analysis of Total Particulate</u>: Filters will be pre-weighed in the Biomonitoring Lab and delivered to the industrial hygienist prior to sampling.

1. Equipment

a. Mettler Type M5 SA, 6 place electronic balance.
b. Forceps

c. Filters: SKC 225-17-04 PTFE (teflon) with polypropylene web supports
d. Filter holders: SKC 225-2 clear polystyrene

2. Gravimetric Procedure

a. Assign and mark numbers on each filter holder
b. Remove a filter from the pack using forceps
c. Place filter in weighing chamber and weigh according to balance instructions
d. record the weight and remove the filter, placing it directly into a cassette. Seal the cassette. Note the number of the cassette on data sheet along with the filter weight. Do all filters needed for analysis.
e. When samples return. Place filter cassettes in desiccator, sealed overnight.
f. Note the number of the sample; Release the filter from the holder and weigh the sample as before. Record the post-sampling weight. Deduct the pre-sampling weight from the post-sampling weight and report this as net sample weight. Place the filter in a numbered 50 mm Petri dish which should be labelled, taped shut and placed in a -20°C freezer until analysis.

Appendix C

NIST Calibration Certificate

CERTIFICATE OF CALIBRATION
for

ULTRAFLO™ CALIBRATOR

DATE 5-22-95

Model No. 709 S.N. 010573

This is to certify that this unit was calibrated against National Institute of Standards & Technology (NIST) test no. IR-74-461 utilizing a 1,000 ml buret, Kimble No. 17801 or 4,000 ml buret, Kimble No. 001 with an electronic digital stop watch S.N. 084150 or 072283 which is also NIST traceable in compliance to MIL-STD-45662-A.

Calibration was conducted for SKC, Inc. with A.P. Buck Calibration Procedure APB-1 rev. 5.0 at 25° C with a constant flow pump using the soap film technique.

An annual verification of calibration is recommended.

Chandrika Panchal
Calibrated By

Albert P Buck
Approved By

x:worddoc\slh\ultracrt.DOC
03/27/95 Ultraflow

Appendix D

Data Sheet

Data Sheet

AF/DoD Feasibility Study - Jet Fuel

DATE: / /1995

BASE: ____________________

NAME: ______________________________

SSN: ____________________

ZONE/WORK AREA: ___________________

AFSC/OS: ________________

BUILDING #: _______________________

RANK: ____________________

GENDER: ___ FEMALE ___MALE

DOB: __________________

JOB TITLE/DESCRIPTION: ____

____

PPE: ____

PUMP #: _________________________

SAMPLE #: ________________

PUMP MAKE/MODEL: ____

MEDIA: ___________________________

ANALYTE: ______________

CALIBRATOR ID: ____
(Last Factory Cal. Date:)

CALIBRATOR MAKE/MODEL: ____

SAMPLE PRE-CAL

DATE: / /95

FLOWRATE: __________

SAMPLE POST-CAL

DATE: / /95

FLOWRATE: _________

SAMPLE START TIME: ________

SAMPLE STOP TIME: ________

AVE. FLOWRATE: ______________ (Ave. over the entire sample period)

SAMPLE DURATION (TOTAL): ________________minutes

TOTAL SAMPLE VOLUME: ____________________LITERS

NOTES: ____

____

____

CLIMATIC CONDITIONS:

TIME:______	TIME:______	TIME:______
TEMP:______	TEMP:______	TEMP:______
RH:______%	RH:______%	RH:______%
BP:______	BP:______	BP:______

GENERAL DESCRIPTION OF CONDITIONS:____________________

____

____

SUPPLEMENTARY QUESTIONS:

1. How long have you been at your current job/position?

2. Do you notice any physical symptoms or health affects that you feel are related to your job or job environment? If so, what are they?

3. Do you have any specific worries or concerns associated with your job? If so, what are they?

DAILY ACTIVITIES LOG

TIME	DESCRIPTION OF ACTIVITY	WORK LOAD*

SAMPLE COLLECTED BY:____________________________ DATE:______________

* 1 = Seated Work, 2 = Work with one arm, 3 = Work with both arms, 4 = Light whole body work, 5 = Moderate whole body work

Post-Shift Questions

1) In your opinion, was the activity level during today's shift:

   A) Average compared to other days.

   B) Low compared to other days.

   C) High compared to other days.

   (Please circle one answer)

2) Did any unususal events occur during your shift. If so what were they?

Appendix E

Air Force Form 2750

INDUSTRIAL HYGIENE SAMPLING DATA

OEHL USE ONLY

(Use this space for mechanical imprint)

WORKPLACE IDENTIFIER 0086

BASE	ORGANIZATION
Base B	

WORKPLACE

DATE COLLECTED (YYMMDD)	BLDG NO./LOCATION	ROOM/AREA
9 5 0 7		

MAIL REPORTS TO (circle if changed)		
ORIGINAL	0 0 8 6	DR. DONNA OLSEN
COPY 1		75th AEROSPACE MEDICINE SQUADRON SGPM / BLDG. 249
COPY 2		7328 SIXTH ST. HILL AFB, UTAH 84056

SAMPLE COLLECTED BY (Name, grade, AFSC)	SIGNATURE	AUTOVON
EDWARD S. PUHALA II	[signature] II	777-1049

REASON FOR SUBMISSION: H O

A-ACCIDENT/INCIDENT C-COMPLAINT F-FOLLOWUP/CLEANUP
R-ROUTINE/PERIODIC SURVEY O-OTHER *(Specify)* UNIV. OF CINCINNATI

OEHL PID

SOURCE BEING SAMPLED

EXISTING CONTROLS *(Personal Protective Equipment, Engineering, Administrative)*

SAMPLE COLLECTION DATA

EMPLOYEE NAME & SSAN OR SAMPLE LOCATION					
OEHL SAMPLE NO.					
BASE SAMPLE NO.					
COLLECTING MEDIA			CTXX 101	CTXX 101	
ANALYSES REQUESTED	A	NAME	XYLENE	JP4	
		NIOSH NO.	001330207		
	B	NAME	TOLUENE	PET. DISTILLATES	
		NIOSH NO.	000108883	SE7449000	
	C	NAME	111 TRICH	TOTAL HYDROCARBONS	
		NIOSH NO.	000071556		
	D	NAME	BENZENE		
		NIOSH NO.	CY1400000		
PUMP OR MONITOR NO.					
COLLECTION TIME: OFF/ON			/	/	/
TOTAL COLLECTION TIME					
FLOW RATE: ON/OFF			/	/	/
VOLUME SAMPLED					
TEMPERATURE/BAROMETER			/	/	/
RELATIVE HUMIDITY/WIND			/	/	/
SUPPORTING SAMPLES	OEHL SAMPLE NO.				
	BASE SAMPLE NO.				
	NOMENCLATURE				

COMMENTS

PRIORITY SAMPLES

SUMMARY OF SURVEY RESULTS *(See reverse for calculations)*

CALCULATED EXPOSURE CONCENTRATIONS	STANDARDS

AF FORM JAN 81 2750

Appendix F

Industrial Hygiene Procedures:

Postural Sway Assessment

Industrial hygiene procedures: postural sway assessment

POSTURAL BALANCE TESTING PROTOCOL

As postural control systems are compromised, changes in sway pattern can be quantified through mapping of increased postural sway. A microcomputer-based force platform system (AMTI Inc., Mass.) is used to collect postural sway data. This force platform is equipped with "hall effect" sensors with a built-in microprocessor to capture signals of forces and moments in three axis (F_x, F_y, F_z) and transfer them directly to the microcomputer via an RS-232 serial port. Data is acquired at 50Hz sampling rate and is transmitted through the RS-232 interface at 9600 baud.

To accurately measure postural sway, all subjects perform two trials of four separate **30 second** postural sway tests. Each test is developed to task separate portions or combinations thereof in the subjects postural control systems. The visual, proprioceptive, and vestibular systems are identified as the primary neurological systems controlling postural sway. Postural sway testing method follows approved protocol established in the University of Cincinnati Institutional Review Board Protocol. The following tests are conducted:

TEST	PROTOCOL	PRIMARY AFFERENT SYSTEMS TESTED
EO	eyes open, standing on bare force platform	Visual, Proprioceptive, Vestibular
EC	eyes closed, standing on bare force platform	Proprioceptive, Vestibular (removes the visual system)
FO	eyes open, standing on 4 inch foam covered force platform	Visual, Vestibular (destablizes the proprioceptive system)
FC	eyes closed, standing on 4 inch foam covered force platform	Vestibular (removes visual and destablizes the proprioceptive system)

During subject alignment prior to testing, foot angle is established at 30 degrees apart by use of a wedge. Exact foot placement is maintained by drawing an outline of the subject's feet on the plate cover and realigning the subject into the traced pattern between tests.

The data collected during testing is analyzed with the Body Balance Software developed by the University of Cincinnati (All Rights Reserved 1995). The software calculates the x-y coordinates of the body's center of pressure for each test. Area and length are used to characterize sway patterns. Total sway area is defined as the area enclosed within the envelope of the outer perimeter of the x-y plot of the center of pressure. Total sway length is determined by the distance in centimeters traversed by the center of pressure during the test period.

Appendix G:

Subject Selection

Industrial hygiene procedures: subject selection

Algorithm for prioritized selection of

Subjects for jp-4 or jp-8 personal air sampling:

Revised 8/28/95

Goal: to identify afsc/oss which contain a minimum of five female personnel who are working in zones with a previous history of elevated exposures to jp-4 and/or benzene.

Assumptions: this algorithm assumes that previous exposure to jp-4 is a fair indicator of current exposures to jp-4 or jp-8. It further assumes that historical exposure to benzene are correlated to historical exposures to jp-4 in areas where jp-4 was in use.

When historical exposure data is available:

1) identify the afsc/os(s) associated with the zones which have,historically, the highest personnel exposure levels to jp-4 and benzene.

   If the number of women associated with the afsc/os(s) is determined to be < 5 go to 2).

If the number of women associated with these Afsc/os(s) are determined to be > 5 then:

a) rate the zones of historically high exposure from greatest to least exposure.

b) choose the afsc/os(s) associated with the zone(s) of highest exposure as ranked in a).

c) identify five female personnel with the anticipated highest exposures, and their corresponding afsc/os(s).

2) choose the afsc/os(s) which are known to contain female personnel from zones with historically elevated personnel exposures to jp-4 and benzene.

If the number of women associated with the afsc/os(s)determined in 1) and 2) is < 5, go to 3).

3) choose the afsc/os(s) which are known to contain female personnel from zones with historically elevated personnel exposures to jp-4 alone.

If the number of women associated with the afsc/os(s) determined in 1), 2) and 3) is < 5,go to 4).

4) choose the afsc/os(s) which are known to contain female personnel from zones with historically elevated personnel exposures to benzene alone. Go to 5).

5) repeat this process, except choose male personnel.

6) the selections made prior to a site visit, and based upon historical sampling data, may be amended or altered at the time of the ih walk-through if changes in work conditions or demographics warrant.

<u>When no historical exposure data is available</u>:

1) identify the zone(s) where exposure(s) to jet fuel is anticipated.

2) rate the frequency of the exposure(s) in each zone as 'daily', 'weekly', 'monthly', etc.

2) identify the zone(s) where daily exposure to jet fuels are anticipated.

3) identify the afsc/os(s) associated with those zones where frequent routine exposure to jet fuel is anticipated.

4) evaluate the true potential for exposure for each of the identified zones and afsc/oss at the time of the ih walk through.

Appendix H

Preselected Potential Exposure Zones

1. Base A
2. Base B
3. Base C

Base A: Preselected Potential Exposure Zones for Jet Fuel Air Sampling

AFSC	CIV-MIL	# MALE	# FEMS	WORKPLACE	JF	EXH	HYD	EXP FREQ	WORKPLACE DESCRIPTION
2A651A	C-48M48	43	5	JET ENG TEST CELL	Y	Y	N	D	Run up engines
3E452	C-2M5	4	3	LIQUID FUELS	Y	Y	Y	D	Jet Fuel
2A674	C-1M1	2	0	C-17 FUEL SYS REPAIR	Y	Y	Y	D	Fuel Cell Repair
4MOX1	C-2M27	22	7	PHYSIOLOGICAL SUPT	Y	Y	Y	D	Aircraft test
2A751	C-17M11	27	1	AIRCRAFT METALS	Y	Y	N	D	Welding
2A674	C-7M21	27	1	FUEL SYS REPAIR	Y	Y	Y	D	Fuel Cell Repair
2F071	C-5	5	0	FUEL STORAGE	Y	Y	Y	D	Fuel storage
2A7X3	C-13M20	33	0	CORROSION CONTROL	Y	Y	Y	D	Sand/paint aircraft
2T352B	C-1M2	3	0	REFUELER MAINT	Y	Y	N	D	Fuel truck repair
3E1X1	C-22M26	45	3	CE ZONE 1	Y	Y	N	D	Flightline Operation
2A332	C-0M6	6	0	SENSORS	Y	Y	N	D	Aircraft operations
3E0X1	C-5M13	18	0	EXTERIOR ELECTRIC	Y	Y	N	D	On flightline
3E751	C-70M54	99	2	FIRE STATIONS	Y	Y	Y	D	Fire dept
5767	C-21M19	37	4	F-100 ENGINES	Y	Y	N	D	Repair engines
5767	C-3M7	10	0	J-79 ENGINES	Y	Y	N	D	Same
5767	C-6M7	13	0	F-110 ENGINES	Y	Y	N	D	Same
2A6X3	C-7M17	24	0	EGRESS	Y	Y	N	D	Aircraft repair
8602	C-6M0	4	2	ACCESORIES LAB	Y	Y	N	D	Engine parts
2892	C-2M3	5	0	BATTERY	Y	Y	N	D	Aircraft batteries
2A6X2	C-25M83	100	8	AGE FLIGHT	Y	Y	Y	D	Aircraft power start
2892	C-0M8	7	1	ARMAMENT	Y	Y	N	D	Aircraft arms
4F0X1	C-0M17	12	5	AEROSPACE MED	Y	Y	Y	D	Flight medicine
3105	C-3M8	9	2	LIFE SUPPORT	Y	Y	N	D	Aircraft life support
HO2865B	C-0M21	18	3	TEST PILOT	Y	Y	Y	D	Pilot
160X1	C-0M7	3	5	BASE OPERATIONS	Y	Y	N	D	Transient aircraft
160X1	C-0M7	3	5	AIR FIELD MAG	Y	Y	Y	D	Work on flightline
2A673	C-22M20	42	8	QA	Y	Y	N	D	Inspect maint. areas
2005	C-2/M8	10	0	AFTERBURNER	Y	Y	N		
3416	C-4M8	10	4	METALS TECH	Y	Y	N	D	Welding on aircraft

Base B - Priority Zones and AFSC/OSs for Jet Fuel Air Sampling
Based upon Historical Sampling Data and/or
Number of Female Personnel

Zone	Zone Description	Previous Sampling	AFSC/OSs	Job Title	#Women	#Men
225P1	F16 Fuels	Benzene, Benzin,	8268		1	23
		2-Butanone, Cadmium, 1,1,2-TCE, JP-4				
43A1	Fuel Sys Repair	Benzene, JP-4	2A634	Aircraft Fuel Sys Aprenti	0	14
			2A654	Aircraft Fuel Sys Journey	0	12
			2A674	Aircraft Fuel Sys Craftsm	0	7
			2A690		0	1
Z136	Fuel/Defuel	JP-4	2892		0	3
			8268		0	11
			8852		0	5
1AN1	C130 Maintenance	Benzene, JP-4	2A551J		1	9
237A2	Fuels 237	N/A	2A654	Aircraft Fuel Sys Journey	0	9
			2A674	Aircraft Fuel Sys Craftsm	1	3
960A4	4CMU (Flightline)	N/A	2W031B		1	2
			2W051		0	7
			2W071		0	1
Z486	Flightline 592	Acetic Acid	8801		0	4
			8852		1	0
8A1	Jet Eng Test Cell	N/A	2A651A		1	5
			2A671A		0	5
			2A691		0	1

Base C - Preselected Potential Exposure Zones for Jet Fuel Air Sampling

Based upon Historical Sampling

Zone	Zone Description	Previous Sampling	AFSC/OSs	#Women	#Men
510A	Fuel Cell	Benzene, JP-4	8268	0	1
			2A654	0	1
			2A674	0	1
203A	Fuel Servicing	Benzene, JP-4	5413	1	1
			1910	0	1
512A	Jet Eng Int Maint	Benzene, JP-4	8602	0	1
			8801	0	1
134A	F100 Fuel Ctrl Test	Benzene	0802	0	1
			3705	0	1
			8255	1	1
			8602	0	1
620A	Liquid Fuels	Benzene	Unk		

Appendix I

Sampling Results

1. Base A
2. Base B
3. Base C

AIR SAMPLING RESULTS

USAF/ University of Cincinnati Jet Fuel Feasability Study

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
017	09/13/95	EZ950041 [95048395]	Base A	2A651A	Not Used	3804 Test Cell	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.532	<0.118	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
Blank	09/13/95	BK950049 [95048396]	Base A	N/A	Not Used	Field Blank	JP-8	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	0.050	0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
018	09/13/95	EZ950042 [95048397]	Base A	2A6X1A	Not Used	3804 Test Cell (outdoors - flightline)	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	<0.505	<0.112	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
016	09/13/95	EZ950043 [95048398]	Base A	2A651A	Not Used	3804 Test Cell (outdoors - flightline)	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	1.56	0.347	300
								Toluene	<0.010	<0.003	50
								m-Xylene	0.10	0.023	100
								o-Xylene	0.03	0.007	100
								p-Xylene	0.06	0.014	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
015	09/13/95	EZ950044 [95048399]	Base A	2A6X1A	Not Used	3804 Test Cell	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	0.850	0.189	300
								Toluene	<0.011	<0.003	50
								m-Xylene	0.03	0.007	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	0.02	0.005	100
019	09/13/95	EZ950046 [95048401]	Base A	2A6X1A	Not Used	3804 Test Cell (outdoors - flightline)	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.526	<0.117	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
020	09/13/95	EZ950048 [95048402]	Base A	2A6X1A	Not Used	3804 Test Cell	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	0.86	0.191	300
								Toluene	<0.010	<0.003	50
								m-Xylene	0.03	0.007	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	0.02	0.005	100
Blank	09/14/95	BK950058 [95048404]	Base A	N/A	Not Used	Field Blank	JP-8	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
015	09/14/95	EZ950055 [95048409]	Base A	2A6X1A	Not Used	3804 Test Cell	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	0.72	0.160	300
								Toluene	<0.010	<0.003	50
								m-Xylene	0.02	0.005	100
								o-Xylene	0.02	0.005	100
								p-Xylene	0.02	0.005	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
023	09/13/95	EZ950045 [95048400]	Base A	2F031	Not Used	95 Supply/LGFCD (outdoors - flightline)	JP-8	Benzene	0.05	0.016	10, A2
								Heptane	0.14	0.034	400
								Naphthas	11.3	2.512	300
								Toluene	0.20	0.053	50
								m-Xylene	0.15	0.035	100
								o-Xylene	0.07	0.016	100
								p-Xylene	0.08	0.018	100
021	09/14/95	EZ950050 [95048403]	Base A	2F031	Not Used	95 Supply/LGCFD (outdoors - flightline)	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	3.66	0.814	300
								Toluene	0.076	0.020	50
								m-Xylene	0.03	0.007	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	0.02	0.005	100
023	09/14/95	EZ950051 [95048405]	Base A	2F031	Not Used	95 Supply/LGFCD (outdoors - flightline)	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.568	<0.126	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
020	09/14/95	EZ950052 [95048406]	Base A	2A6X1A	Not Used	3804 Test Cell	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	<0.490	<0.109	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
017	09/14/95	EZ950053 [95048407]	Base A	2A651A	Not Used	3804 Test Cell	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	0.95	0.211	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
019	09/14/95	EZ950054 [95048408]	Base A	2A6X1A	Not Used	3804 Test Cell (outdoors - flightline)	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	<0.52	<0.116	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
016	09/14/95	EZ950056 [95048410]	Base A	2A651A	Not Used	3804 Test Cell (outdoors - flightline)	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	<0.49	<0.109	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
018	09/14/95	EZ950057 [95048411]	Base A	2A6X1A	Not Used	3804 Test Cell (outdoors - flightline)	JP-8	Benzene	<0.010	<0.003	10, A2
								Heptane	<0.010	<0.002	400
								Naphthas	<0.48	<0.107	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
012	09/18/95	EZ950059 [95048412]	Base A	2A6518	Not Used	3800 TF33/J85 Section	JP-8	Benzene	<0.012	<0.004	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	2.16	0.480	300
								Toluene	0.114	0.030	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
Blank	09/18/95	BK950067 [95048413]	Base A	N/A	Not Used	Field Blank	JP-8	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
026	09/18/95	EZ950060 [95048414]	Base A	2A671A	Not Used	3810 JEIM	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	0.66	0.147	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
025	09/18/95	EZ950063 [95048416]	Base A	2A671A	Not Used	3810 7100 Section	JP-8	Benzene	<0.012	<0.004	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	<0.602	<0.134	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
013	09/18/95	EZ950064 [95048417]	Base A	N/A	Not Used	3800 Accs Lab	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	6.65	1.478	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
014	09/18/95	EZ950065 [95048418]	Base A	2A651A	Not Used	3810 F100 Section	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.561	<0.125	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
027	09/18/95	EZ950062 [95048415]	Base A	2A634	Not Used	412 CRS Fuel Systems	JP-8	Benzene	<0.013	<0.004	10, A2
								Heptane	<0.013	<0.003	400
								Naphthas	<0.641	<0.142	300
								Toluene	<0.013	<0.003	50
								m-Xylene	<0.013	<0.003	100
								o-Xylene	<0.013	<0.003	100
								p-Xylene	<0.013	<0.003	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
022	09/18/95	EZ950066 [95048419]	Base A	2A6X4	Not Used	412 CRS Fuel Systems	JP-8	Benzene	<0.013	<0.004	10, A2
								Heptane	<0.013	<0.003	400
								Naphthas	<0.667	<0.148	300
								Toluene	<0.013	<0.003	50
								m-Xylene	<0.013	<0.003	100
								o-Xylene	<0.013	<0.003	100
								p-Xylene	<0.013	<0.003	100
022	09/19/95	EZ950071 [95048420]	Base A	2A6X4	Not Used	412 CRS Fuel Systems	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	3.29	0.731	300
								Toluene	<0.011	<0.003	50
								m-Xylene	0.10	0.023	100
								o-Xylene	0.07	0.016	100
								p-Xylene	0.10	0.023	100
Blank	09/19/95	BK950068 [95048421]	Base A	N/A	Not Used	Field Blank	JP-8	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
027	09/19/95	EZ950074 [95048424]	Base A	2A634	Not Used	412 CRS Fuel Systems	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.532	<0.118	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
012	09/19/95	EZ950072 [95048422]	Base A	2A6518	Not Used	3800 TF33/J85 Section	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.526	<0.117	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
013	09/19/95	EZ950073 [95048423]	Base A	N/A	Not Used	3800 Accs Lab	JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	3.95	0.878	300
								Toluene	<0.011	<0.003	50
								m-Xylene	0.02	0.005	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	0.02	0.005	100
008	07/12/95	EZ950004 [95041723]	Base B	2A332B	45B4	421 FS APG (outdoors - flightline)	JP-4	Benzene	<0.011	<0.003	10, A2
								Naphthas	1.77	0.393	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
003	07/12/95	EZ950006 [95041726]	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.012	<0.004	10, A2
								Naphthas	1.81	0.402	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
Blank	7/12/95	BK950013 [95041724]	Base B	N/A	N/A	Field Blank	JP-4	Benzene	<0.001	<0.001	10, A2
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
004	07/12/95	EZ950001 [95041720]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	0.154	0.048	10, A2
								Naphthas	13.5	3.001	300
								Toluene	0.474	0.126	50
								m-Xylene	1.153	0.265	100
								o-Xylene	0.615	0.142	100
								p-Xylene	0.381	0.088	100
002	07/12/95	EZ950002 [95041722]	Base B	2A654	43A1	388 MS Fuels Shop	JP-4	Benzene	0.148	0.046	10, A2
								Naphthas	8.24	1.832	300
								Toluene	0.322	0.085	50
								m-Xylene	0.541	0.125	100
								o-Xylene	0.197	0.045	100
								p-Xylene	0.200	0.046	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
005	07/12/95	EZ950011	Base B	8268	225I2	225 C-130 Fuels	JP-4	Benzene	0.180	0.056	10, A2
		[95041729]						Naphthas	22.9	5.090	300
								Toluene	0.632	0.168	50
								m-Xylene	1.102	0.254	100
								o-Xylene	0.892	0.205	100
								p-Xylene	0.756	0.174	100
Blank	7/12/95	BK950003	Base B	N/A	N/A	Field Blank	JP-4	Benzene	<0.001	<0.001	10, A2
		[95041721]						Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
004	07/13/95	EZ950009	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	<0.011	<0.003	10, A2
		[95041727]						Naphthas	2.17	0.482	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
Blank	07/13/95	BK950008	Base B	N/A	N/A	Field Blank	JP-4	Benzene	<0.001	<0.001	10, A2
		[95041728]						Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
003	07/13/95	EZ950012	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.011	<0.003	10, A2
		[95041730]						Naphthas	3.62	0.805	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
006	07/13/95	EZ950014	Base B	2F051	914B2	Petroleum Flight 914	JP-4	Benzene	0.109	0.034	10, A2
		[95041731]				(outdoors - flightline)		Naphthas	11.1	2.467	300
								Toluene	0.103	0.027	50
								m-Xylene	0.101	0.023	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	0.023	0.005	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER		AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
Blank	07/13/95	BK950007 [95041733]	Base B	N/A	N/A	Field Blank	JP-4	Benzene	<0.001	<0.001	10, A2
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
008	07/13/95	EZ950005 [95041725]	Base B	2A332B	45B4	421 FS APG (outdoors - flightline)	JP-4	Benzene	<0.012	<0.004	10, A2
								Naphthas	1.72	0.382	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
005	07/13/95	EZ950015 [95041732]	Base B	8268	225I2	225 C-130 Fuels	JP-4	Benzene	<0.014	<0.004	10, A2
								Naphthas	27.9	6.201	300
								Toluene	0.134	0.036	50
								m-Xylene	1.767	0.407	100
								o-Xylene	1.284	0.296	100
								p-Xylene	1.278	0.294	100
053	09/19/95	EZ950038 [96001411]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	<0.008	<0.003	10, A2
								1,1,1-Trich.	2.71	0.498	350
								Naphthas	3.28	0.729	300
								Toluene	<0.008	<0.002	50
								m-Xylene	<0.008	<0.002	100
								o-Xylene	<0.008	<0.002	100
								p-Xylene	<0.008	<0.002	100
053	9/20/95	EZ950039 [96001412]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	0.047	0.015	10, A2
								1,1,1-Trich.	1.143	0.210	350
								Naphthas	30.9	6.868	300
								Toluene	0.284	0.075	50
								m-Xylene	0.319	0.073	100
								o-Xylene	0.202	0.047	100
								p-Xylene	0.163	0.038	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER		AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
046	09/11/95	EZ950024 [96001397]	Base B	2W151	45B3	421 FS Weapons (outdoors - flightline)	JP-4	Benzene	<0.009	<0.003	10, A2
								1,1,1-Trich.	<0.075	<0.014	350
								Naphthas	1.12	0.249	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
046	09/12/95	EZ950025 [96001398]	Base B	2W151	45B3	421 FS Weapons (outdoors - flightline)	JP-4	Benzene	<0.009	<0.003	10, A2
								1,1,1-Trich.	<0.074	<0.014	350
								Naphthas	<0.465	<0.103	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
047	09/19/95	EZ950040 [96001413]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	<0.008	<0.003	10, A2
								1,1,1-Trich.	4.01	0.737	350
								Naphthas	11.2	2.489	300
								Toluene	0.149	0.040	50
								m-Xylene	0.076	0.017	100
								o-Xylene	0.012	0.003	100
								p-Xylene	<0.008	<0.002	100
047	09/20/95	EZ950041 [96001414]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	<0.009	<0.003	10, A2
								Naphthas	11.5	2.556	300
								Toluene	0.193	0.051	50
								m-Xylene	0.080	0.018	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
049	09/11/95	EZ950018 [96001391]	Base B	2W151	45B3	421 FS Weapons (outdoors - flightline)	JP-4	Benzene	<0.011	<0.003	10, A2
								1,1,1-Trich.	<0.011	<0.002	350
								Naphthas	5.69	1.265	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
049	09/12/95	EZ950019	Base B	2W151	45B3	421 FS Weapons	JP-4	Benzene	<0.010	<0.002	10, A2
		[96001392]				(outdoors - flightline)		1,1,1-Trich.	<0.079	<0.025	350
								Naphthas	<0.494	<0.110	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
050	09/11/95	EZ950020	Base B	2A634	43A1	388 Fuel Sys	JP-4	Benzene	<0.010	<0.003	10, A2
		[96001393]						1,1,1-Trich.	<0.082	<0.015	350
								Naphthas	<0.513	<0.114	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
050	09/12/95	EZ950021	Base B	2A634	43A1	388 Fuel Sys	JP-4	Benzene	<0.010	<0.003	10, A2
		[96001394]						1,1,1-Trich.	<0.081	<0.015	350
								Naphthas	<0.509	<0.113	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
052	09/20/95	EZ950044	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.009	<0.003	10, A2
		[96001417]						1,1,1-Trich.	2.03	0.373	350
								Naphthas	6.78	1.507	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
052	09/21/95	EZ950045	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.009	<0.003	10, A2
		[96001418]						1,1,1-Trich.	0.032	0.006	350
								Naphthas	4.54	1.009	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
054	09/13/95	EZ950026	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	0.025	0.008	10, A2
		[96001399]						1,1,1-Trich.	2.49	0.458	350
								Naphthas	28.8	6.401	300
								Toluene	0.228	0.061	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	0.059	0.014	100
								p-Xylene	0.203	0.047	100
054	09/14/95	EZ950027	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	0.038	0.012	10, A2
		[96001400]						1,1,1-Trich.	31.74	5.835	350
								Naphthas	36.5	8.113	300
								Toluene	5.49	1.457	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
056	09/06/95	EZ950016	Base B	8268	225I2	225 C130 Fuels	JP-4	Benzene	<0.009	<0.003	10, A2
		[96001389]						1,1,1-Trich.	0.278	0.051	350
								Naphthas	2.93	0.651	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
056	09/07/95	EZ950017	Base B	8268	225I2	225 C130 Fuels	JP-4	Benzene	<0.009	<0.003	10, A2
		[96001390]						1,1,1-Trich.	0.494	0.091	350
								Naphthas	21.7	4.823	300
								Toluene	0.089	0.024	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
057	09/13/95	EZ950028	Base B	2A634	43A1	388 Fuel Systems	JP-4	Benzene	<0.010	<0.003	10, A2
		[96001401]						1,1,1-Trich.	<0.078	<0.014	350
								Naphthas	17.5	3.890	300
								Toluene	0.037	0.010	50
								m-Xylene	0.362	0.083	100
								o-Xylene	0.047	0.011	100
								p-Xylene	0.198	0.046	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
057	09/14/95	EZ950029 [96001402]	Base B	2A634	43A1	388 Fuel Systems	JP-4	Benzene	<0.009	<0.003	10, A2
								1,1,1-Trich.	<0.073	<0.013	350
								Naphthas	1.74	0.387	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
058	09/13/95	EZ950032 [96001405]	Base B	2A634	43A1	388 Fuel Systems	JP-4	Benzene	<0.010	<0.003	10, A2
								1,1,1-Trich.	<0.082	<0.015	350
								Naphthas	<0.513	<0.114	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
058	09/14/95	EZ950033 [96001406]	Base B	2A634	43A1	388 Fuel Systems	JP-4	Benzene	<0.010	<0.003	10, A2
								1,1,1-Trich.	<0.081	<0.015	350
								Naphthas	<0.506	<0.112	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
059	09/19/95	EZ950034 [9601411]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	0.211	0.066	10, A2
								1,1,1-Trich.	1.796	0.330	350
								Naphthas	21.2	4.712	300
								Toluene	0.569	0.151	50
								m-Xylene	0.310	0.071	100
								o-Xylene	0.075	0.017	100
								p-Xylene	0.039	0.009	100
059	09/20/95	EZ950035 [96001408]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	<0.009	<0.003	10, A2
								1,1,1-Trich.	1.696	0.312	350
								Naphthas	6.14	1.365	300
								Toluene	0.156	0.041	50
								m-Xylene	0.090	0.021	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
060	09/13/95	EZ950030 [96001403]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	<0.009	<0.003	10, A2
								1,1,1-Trich.	<0.074	<0.014	350
								Naphthas	2.92	0.649	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
060	09/14/95	EZ950031 [96001404]	Base B	8268	225P1	225 F16 Fuels	JP-4	Benzene	<0.010	<0.003	10, A2
								1,1,1-Trich.	4.74	0.871	350
								Naphthas	4.06	0.902	300
								Toluene	0.062	0.016	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
061	09/11/95	EZ950022 [96001395]	Base B	2A636	45B2	421 FS Avionics (outdoors - flightline)	JP-4	Benzene	<0.010	<0.003	10, A2
								1,1,1-Trich.	<0.079	<0.015	350
								Naphthas	<0.496	<0.110	300
								Toluene	<0.010	<0.003	50
								m-Xylene	<0.010	<0.002	100
								o-Xylene	<0.010	<0.002	100
								p-Xylene	<0.010	<0.002	100
061	09/12/95	EZ950023 [96001396]	Base B	2A636	45B2	421 FS Avionics (outdoors - flightline)	JP-4	Benzene	<0.011	<0.003	10, A2
								1,1,1-Trich.	<0.089	<0.016	350
								Naphthas	<0.557	<0.124	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
062	09/19/95	EZ950036 [96001409]	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.009	<0.003	10, A2
								1,1,1-Trich.	2.67	0.491	350
								Naphthas	10.0	2.223	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
062	09/20/95	EZ950037	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.009	<0.003	10, A2
		[96001410]						1,1,1-Trich.	1.23	0.226	350
								Naphthas	0.970	0.216	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
063	09/19/95	EZ950042	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.009	<0.003	10, A2
		[96001415]						1,1,1-Trich.	1.44	0.265	350
								Naphthas	1.00	0.222	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
063	09/20/95	EZ950043	Base B	3806	225Q1	225 Sheetmetal	JP-4	Benzene	<0.009	<0.003	10, A2
		[96001416]						1,1,1-Trich.	2.740	0.504	350
								Naphthas	1.71	0.380	300
								Toluene	<0.009	<0.002	50
								m-Xylene	<0.009	<0.002	100
								o-Xylene	<0.009	<0.002	100
								p-Xylene	<0.009	<0.002	100
Blank	09/21/95	BK950046	Base B	N/A	N/A	Field Blank	JP-4	Benzene	<0.001	<0.001	10, A2
		[96001419]						1,1,1-Trich.	<0.001	<0.001	350
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
Blank	09/21/95	BK950047	Base B	N/A	N/A	Field Blank	JP-4	Benzene	<0.001	<0.001	10, A2
		[96001420]						1,1,1-Trich.	<0.001	<0.001	350
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
044	09/29/95	EZ950082 [96001589]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-5	Benzene	0.093	0.029	10, A2
								Heptane	0.223	0.054	400
								Naphthas	18.2	4.045	300
								Toluene	0.278	0.074	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	0.090	0.021	100
								p-Xylene	<0.012	<0.003	100
Blank	09/29/95	BK950086 [96001590]	Base C	N/A	N/A	Field Blank	JP-5	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
041	09/29/95	EZ950087 [96001594]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-5	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.575	<0.128	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
042	09/29/95	EZ950088 [96001595]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-5	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.575	<0.128	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100
034	09/29/95	EZ950083 [96001591]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-5/JP-8	Benzene	<0.011	<0.003	10, A2
								Heptane	<0.011	<0.003	400
								Naphthas	<0.575	<0.128	300
								Toluene	<0.011	<0.003	50
								m-Xylene	<0.011	<0.003	100
								o-Xylene	<0.011	<0.003	100
								p-Xylene	<0.011	<0.003	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
035	09/29/95	EZ950084 [96001592]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-5	Benzene	0.021	0.007	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	9.42	2.094	300
								Toluene	0.042	0.011	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
045	09/29/95	EZ950085 [96001593]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-8	Benzene	<0.012	<0.004	10, A2
								Heptane	0.191	0.047	400
								Naphthas	3.23	0.718	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
036	09/29/95	EZ950090 [96001597]	Base C	5413	203A	980 Fuels Storage (outdoors - fuel tank farm)	JP-8	Benzene	<0.015	<0.005	10, A2
								Heptane	<0.015	<0.004	400
								Naphthas	<0.758	<0.168	300
								Toluene	<0.015	<0.004	50
								m-Xylene	<0.015	<0.003	100
								o-Xylene	<0.015	<0.003	100
								p-Xylene	<0.015	<0.003	100
032	09/30/95	EZ950091 [96001598]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-8	Benzene	<0.014	<0.004	10, A2
								Heptane	<0.014	<0.003	400
								Naphthas	<0.684	<0.152	300
								Toluene	<0.014	<0.004	50
								m-Xylene	<0.014	<0.003	100
								o-Xylene	<0.014	<0.003	100
								p-Xylene	<0.014	<0.003	100
Blank	09/30/95	BK950096 [96001599]	Base C	N/A	N/A	Field Blank	JP-5/JP-8	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
028	10/02/95	EZ950092 [96001600]	Base C	5413	042D	655 Test Cell	JP-5	Benzene	0.092	0.029	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	6.70	1.489	300
								Toluene	0.092	0.024	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
Blank	10/02/95	BK950099 [96001601]	Base C	N/A	N/A	Field Blank	JP-5	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	<0.050	<0.011	300
								Toluene	<0.001	<0.001	50
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
								p-Xylene	<0.001	<0.001	100
043	09/29/95	EZ950089 [96001696]	Base C	2892	094A	C5 Flight Prep (outdoors - Pad 30)	JP-5	Benzene	<0.016	<0.005	10, A2
								Heptane	0.270	0.066	400
								Naphthas	10.2	2.267	300
								Toluene	0.194	0.052	50
								m-Xylene	0.468	0.108	100
								o-Xylene	0.100	0.023	100
								p-Xylene	<0.016	<0.004	100
040	09/29/95	PD959164 [96001608]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-5	Benzene	<0.143	<0.045	10, A2
								Heptane	<0.168	<0.041	400
								Naphthas	<7.63	<1.696	300
								Toluene	<0.161	<0.043	50
								m-Xylene	<0.185	<0.043	100
								o-Xylene	<0.185	<0.043	100
								p-Xylene	<0.185	<0.043	100
Blank	09/29/95	BK959220 [96001609]	Base C	N/A	N/A	Field Blank	JP-5	Benzene	<0.002	<0.001	10, A2
								Heptane	<0.002	<0.000	400
								Naphthas	<0.075	<0.017	300
								Toluene	<0.002	<0.001	50
								m-Xylene	<0.002	<0.001	100
								o-Xylene	<0.002	<0.001	100
								p-Xylene	<0.002	<0.001	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
038	09/29/95	PD959408 [96001612]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-5	Benzene	<0.144	<0.045	10, A2
								Heptane	<0.169	<0.041	400
								Naphthas	<7.66	<1.703	300
								Toluene	<0.162	<0.043	50
								m-Xylene	<0.186	<0.043	100
								o-Xylene	<0.186	<0.043	100
								p-Xylene	<0.186	<0.043	100
039	09/29/95	PD959480 [96001614]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-5	Benzene	<0.144	<0.045	10, A2
								Heptane	<0.170	<0.041	400
								Naphthas	<7.68	<1.707	300
								Toluene	<0.163	<0.043	50
								m-Xylene	<0.187	<0.043	100
								o-Xylene	<0.187	<0.043	100
								p-Xylene	<0.187	<0.043	100
033	09/30/95	EZ950093 [96001602]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-8	Benzene	<0.012	<0.004	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	<0.617	<0.137	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
031	09/30/95	EZ950094 [96001603]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-5	Benzene	<0.014	<0.004	10, A2
								Heptane	<0.014	<0.003	400
								Naphthas	<0.694	<0.154	300
								Toluene	<0.014	<0.004	50
								m-Xylene	<0.014	<0.003	100
								o-Xylene	<0.014	<0.003	100
								p-Xylene	<0.014	<0.003	100
030	09/30/95	EZ950095 [96001604]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-8	Benzene	<0.013	<0.004	10, A2
								Heptane	<0.013	<0.003	400
								Naphthas	<0.633	<0.141	300
								Toluene	<0.013	<0.003	50
								m-Xylene	<0.013	<0.003	100
								o-Xylene	<0.013	<0.003	100
								p-Xylene	<0.013	<0.003	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
031	09/30/95	PD959150	Base C	5413	203A	Base Fuels/LGSF	JP-5	Benzene	<0.107	<0.033	10, A2
		[96001606]				(outdoors - flightline)		Heptane	<0.126	<0.031	400
								Naphthas	<5.70	<1.267	300
								Toluene	<0.121	<0.032	50
								m-Xylene	<0.138	<0.032	100
								o-Xylene	<0.138	<0.032	100
								p-Xylene	<0.138	<0.032	100
Blank	09/30/95	BK959437	Base C	N/A	N/A	Field Blank	JP-5	Benzene	<0.002	<0.001	10, A2
		[96001607]						Heptane	<0.002	<0.000	400
								Naphthas	<0.075	<0.017	300
								Toluene	<0.002	<0.001	50
								m-Xylene	<0.002	<0.001	100
								o-Xylene	<0.002	<0.001	100
								p-Xylene	<0.002	<0.001	100
033	09/30/95	PD959281	Base C	5413	203A	Base Fuels/LGSF	JP-5	Benzene	<0.105	<0.033	10, A2
		[96001610]				(outdoors - flightline)		Heptane	<0.123	<0.030	400
								Naphthas	<5.59	<1.243	300
								Toluene	<0.118	<0.031	50
								m-Xylene	<0.136	<0.031	100
								o-Xylene	<0.136	<0.031	100
								p-Xylene	<0.136	<0.031	100
030	09/30/95	PD959285	Base C	5413	203A	Base Fuels/LGSF	JP-5	Benzene	<0.104	<0.033	10, A2
		[96001611]				(outdoors - flightline)		Heptane	<0.122	<0.030	400
								Naphthas	<5.55	<1.234	300
								Toluene	<0.117	<0.031	50
								m-Xylene	<0.135	<0.031	100
								o-Xylene	<0.135	<0.031	100
								p-Xylene	<0.135	<0.031	100
032	09/30/95	PD959451	Base C	5413	203A	Base Fuels/LGSF	JP-5/JP-8	Benzene	<0.106	<0.033	10, A2
		[96001613]				(outdoors - flightline)		Heptane	<0.124	<0.030	400
								Naphthas	<5.65	<1.256	300
								Toluene	<0.119	<0.032	50
								m-Xylene	<0.137	<0.032	100
								o-Xylene	<0.137	<0.032	100
								p-Xylene	<0.137	<0.032	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
029	10/02/95	EZ950097 [96001605]	Base C	8602	041A	655 Test Cell	JP-5	Benzene	<0.012	<0.004	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	<0.602	<0.134	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
038	09/28/95	EZ950069 [96001581]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-8	Benzene	<0.013	<0.004	10, A2
								Heptane	<0.013	<0.003	400
								Naphthas	4.46	0.991	300
								Toluene	0.037	0.010	50
								m-Xylene	<0.013	<0.003	100
								o-Xylene	<0.013	<0.003	100
								p-Xylene	<0.013	<0.003	100
Blank	09/28/95	BK950081 [96001582]	Base C	N/A	N/A	Field Blank	JP-8	Benzene	<0.001	<0.001	10, A2
								Heptane	<0.001	<0.001	400
								Naphthas	<0.050	<0.011	300
								m-Xylene	<0.001	<0.001	100
								o-Xylene	<0.001	<0.001	100
039	09/28/95	EZ950073 [96001584]	Base C	8852	094A	C5 Flight Prep (outdoors - Pad 30)	JP-8	Benzene	<0.013	<0.004	10, A2
								Heptane	<0.013	<0.003	400
								Naphthas	3.39	0.754	300
								Toluene	<0.013	<0.003	50
								m-Xylene	<0.013	<0.003	100
								o-Xylene	<0.013	<0.003	100
								p-Xylene	<0.013	<0.003	100
040	09/28/95	EZ950079 [96001587]	Base C		094A	C5 Flight Prep (outdoors - Pad 30)	JP-8	Benzene	<0.013	<0.004	10, A2
								Heptane	<0.013	<0.003	400
								Naphthas	<0.633	<0.141	300
								Toluene	<0.013	<0.003	50
								m-Xylene	<0.013	<0.003	100
								o-Xylene	<0.013	<0.003	100
								p-Xylene	<0.013	<0.003	100

Coded ID#	SAMPLING DATE	SAMPLE NUMBER	BASE	AFSC/OS	ZONE	SHOP	FUEL TYPE	ANALYTE	RESULT (mg/m3)	RESULT (PPM)	TLV (PPM)
034	09/28/95	EZ950070 [96001583]	Base C		203A	Base Fuels/LGSF (outdoors - flightline)	JP-8	Benzene	<0.012	<0.004	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	<0.595	<0.132	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
045	09/28/95	EZ950077 [96001585]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-8	Benzene	<0.012	<0.004	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	<0.617	<0.137	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100
036	09/28/95	EZ950078 [96001586]	Base C	5413	203A	980 Fuels Storage (outdoors - fuel tank farm)	JP-8	Benzene	<0.014	<0.004	10, A2
								Heptane	<0.014	<0.003	400
								Naphthas	<0.704	<0.156	300
								Toluene	<0.014	<0.004	50
								m-Xylene	<0.014	<0.003	100
								o-Xylene	<0.014	<0.003	100
								p-Xylene	<0.014	<0.003	100
035	09/28/95	EZ950080 [96001588]	Base C	5413	203A	Base Fuels/LGSF (outdoors - flightline)	JP-8	Benzene	<0.012	<0.004	10, A2
								Heptane	<0.012	<0.003	400
								Naphthas	<0.588	<0.131	300
								Toluene	<0.012	<0.003	50
								m-Xylene	<0.012	<0.003	100
								o-Xylene	<0.012	<0.003	100
								p-Xylene	<0.012	<0.003	100

Appendix J

Fuel Characteristics

Fuel Characteristics

(Information drawn from USAF document T.O.42B1-1-14)

Property	JP-4	JP-8	JP-5
Specific Gravity at 60°F(min)	0.751	0.775	0.788
Specific Gravity at 60°F(max)	0.802	0.84	0.845
Specific Gravity at 60°F(typical)[1]	0.769	0.805	0.817
Density, lbs/gallon (typical)[1]	6.4	6.7	6.8
Flash Point, MIN, °C(°F)	-29 (-20)*	38 (100)	60 (140)
Vapor Pressure, psi, (range)	2.0-3.0	----	----
Freezing Point, MIN, °C(°F)	-58 (-72)	-50 (-58)	-46 (-51)
Viscosity at -40°C,CS (estimated)	3.6	15	16.5
BTU per gallon (min)[2]	115,000	119,000	120,000
BTU per pound (min)	18,400	18,400	18,300
Fuel System Icing Inhibitor	yes	yes	yes
Corrosion Inhibitor	yes	yes	yes
Conductivity Additive	yes	yes	no

1 - Typical average for fuels procured since 1970 in continental USA.

2 - Value based on minimum fuel specific gravity from Specification and reported to three significant figures.

* - Typically measured values, no specification requirement stated.

K. Historical Exposures - Database

Historical Sampling Database
(data provided by USAF)

Base	Zone	Analyte	TWA mg/m3	Date	Result mg/m3
Base C	022A	BENZENE	0.176	93-04-15	0.176
Base C	022A	BENZENE	0.176	93-04-15	0.176
Base C	022A	BENZENE	0.176	93-04-15	0.176
Base C	022A	BENZENE	0.176	93-04-16	0.176
Base C	022A	BENZENE	0.176	93-04-19	0.176
Base C	022A	BENZENE	0.176	93-04-19	0.176
Base C	022A	BENZENE	0.176	93-04-19	0.176
Base C	022A	BENZENE	0.29	93-04-16	0.29
Base C	022A	BENZENE	0.44	93-04-16	0.44
Base C	033A	BENZENE	0	92-06-17	0
Base C	133A	BENZENE	0.0103	88-05-27	0.013
Base C	133A	BENZENE	0.0158	88-05-31	0.02
Base C	133A	BENZENE	0.0206	88-05-27	0.026
Base C	133A	BENZENE	0.0245	88-05-31	0.031
Base C	133A	BENZENE	0.0268	88-06-02	0.033
Base C	133A	BENZENE	0.0404	88-05-31	0.051
Base C	133A	BENZENE	0.0447	88-06-02	0.055
Base C	133A	BENZENE	0.1056	88-06-02	0.13
Base C	133A	BENZENE	0.7917	88-06-01	1
Base C	133A	BENZENE	1.5833	88-06-01	2
Base C	134A	BENZENE	1.1719	88-04-11	1.5
Base C	134A	BENZENE	3.225	88-04-15	3.6
Base C	134A	BENZENE	3.225	88-04-15	3.6
Base C	203A	JP-4 Jet Fuel	3.1092	88-12-20	3.64
Base C	203A	JP-4 Jet Fuel	5.7187	88-12-19	7.5
Base C	203A	JP-4 Jet Fuel	12.8125	88-12-20	15
Base C	203A	JP-4 Jet Fuel	18.7917	88-12-20	22
Base C	203A	JP-4 Jet Fuel	21.045	88-12-19	27.6
Base C	402A	BENZENE	0.0034	91-07-02	0.054
Base C	413B	BENZENE	0.1041	93-07-14	0.238
Base C	417A	BENZENE	0.0003	90-09-21	0.005
Base C	417A	BENZENE	0.0004	90-09-21	0.01
Base C	417A	BENZENE	0.0004	90-09-22	0.012
Base C	417A	BENZENE	0.0006	90-09-22	0.014
Base C	417A	BENZENE	0.0022	90-09-21	0.013
Base C	417A	BENZENE	0.0023	90-09-21	0.045
Base C	417A	BENZENE	0.0026	90-09-22	0.038
Base C	417A	BENZENE	0.0032	90-09-22	0.046
Base C	417A	BENZENE	0.0138	90-09-22	0.2
Base C	417A	BENZENE	0.044	90-09-22	0.64
Base C	417A	BENZENE	0.05	90-09-26	1.6
Base C	417A	BENZENE	0.0594	90-09-22	1.9
Base C	417A	BENZENE	0.0906	90-12-22	2.9
Base C	510A	BENZENE	0.0019	90-08-02	0.021
Base C	510A	BENZENE	0.0021	90-10-18	0.03
Base C	510A	BENZENE	0.0027	90-10-18	0.02

Base C	510A		BENZENE	0.003	90-10-18	0.02
Base C	510A		BENZENE	0.0117	90-08-02	0.052
Base C	510A		BENZENE	0.0274	90-08-02	0.135
Base C	510A		BENZENE	0.0449	90-06-29	0.188
Base C	510A		BENZENE	0.0673	90-10-10	0.117
Base C	510A		BENZENE	0.07	90-10-18	0.12
Base C	510A		BENZENE	1.2937	90-04-05	4.6
Base C	510A		BENZENE	1.3656	90-08-02	43.7
Base C	510A		BENZENE	6.5	90-08-02	208
Base C	510A		JP-4 JET FUEL	0.1104	90-06-29	0.461
Base C	510A		JP-4 JET FUEL	0.1844	91-09-04	5.9
Base C	510A		JP-4 JET FUEL	0.2352	90-10-18	3.32
Base C	510A		JP-4 JET FUEL	0.4133	90-10-18	3.2
Base C	510A		JP-4 JET FUEL	0.5094	90-08-02	16.3
Base C	510A		JP-4 JET FUEL	0.5292	90-10-18	3.48
Base C	510A		JP-4 JET FUEL	0.596	90-10-18	4.27
Base C	510A		JP-4 JET FUEL	0.6885	90-08-02	3.06
Base C	510A		JP-4 JET FUEL	0.9303	90-10-18	6.87
Base C	510A		JP-4 JET FUEL	0.9581	90-08-02	10.22
Base C	510A		JP-4 JET FUEL	1.0577	90-08-02	5.234
Base C	510A		JP-4 JET FUEL	1.8438	90-10-22	35.4
Base C	510A		JP-4 JET FUEL	2.1656	90-10-23	6.3
Base C	510A		JP-4 JET FUEL	2.3156	90-10-22	9.5
Base C	510A		JP-4 JET FUEL	2.9425	90-10-20	10.7
Base C	510A		JP-4 JET FUEL	3.729	92-10-23	9.42
Base C	510A		JP-4 JET FUEL	4.844	90-10-22	155
Base C	510A		JP-4 JET FUEL	6.658	90-10-23	9.4
Base C	510A		JP-4 JET FUEL	8.743	90-10-23	12.2
Base C	510A		JP-4 JET FUEL	9.099	90-10-23	12.2
Base C	510A		JP-4 JET FUEL	11.844	90-10-24	379
Base C	510A		JP-4 JET FUEL	14.813	90-10-24	474
Base C	510A		JP-4 JET FUEL	16.399	90-10-10	28.52
Base C	510A		JP-4 JET FUEL	16.678	90-10-18	28.9
Base C	510A		JP-4 JET FUEL	19.361	90-10-18	33.19
Base C	510A		JP-4 JET FUEL	20.57	90-10-22	74.8
Base C	510A		JP-4 JET FUEL	25.298	90-10-23	35.3
Base C	510A		JP-4 JET FUEL	30.728	90-10-23	41.2
Base C	510A		JP-4 JET FUEL	60.667	91-09-04	182
Base C	510A		JP-4 JET FUEL	106.594	90-04-05	379
Base C	510A		JP-4 JET FUEL	205.469	91-09-04	789
Base C	510A		JP-4 JET FUEL	283.031	91-09-04	9057
Base C	510A		JP-4 JET FUEL	435.469	90-08-02	13935
Base C	512A		JP-4 JET FUEL	5.796	90-11-19	53.5
Base C	620A		BENZENE	0.273	94-01-14	1.09
Base C	620A		BENZENE	0.293	91-07-23	0.36
Base C	620A		BENZENE	2.198	92-12-07	3.35
Base C	620A		BENZENE	3.073	92-12-07	4.47
Base C	620A		BENZENE	39.737	92-12-07	57.8
Base C	620A		BENZENE	42.213	92-12-07	61.4
Base B	1AA1	BENZENE		0.0887	92/03/24	0.8691
Base B	1AA1	BENZENE		0.2623	92/03/24	3.4034

Base B	1AA1	BENZENE	0.1066	92/03/24	1.0656
Base B	1AA1	BENZENE	0.055	92/03/24	0.7339
Base B	1AA1	JP-4 JET FUEL	5.009	92/03/24	49.068
Base B	1AA1	JP-4 JET FUEL	15.3778	92/03/24	199.49
Base B	1AA1	JP-4 JET FUEL	6.3068	92/03/24	63.067
Base B	1AA1	JP-4 JET FUEL	3.1358	92/03/24	41.81
Base B	1AA1	BENZENE			1.5238
Base B	1AA1	JP-4 JET			89.42
Base B	1AA1	BENZENE			2.601
Base B	1AA1	JP-4 JET			190.4
Base B	1AA1	BENZENE			0.5158
Base B	1AA1	JP-4 JET			39.19
Base B	1AA1	BENZENE			1.2534
Base B	1AA1	JP-4 JET			88.95
Base B	1D1	BENZENE	0.2818	92/05/13	4.5086
Base B	1D1	JP-4 JET FUEL	5.1771	92/05/13	82.833
Base B	206A1	BENZENE	0.1478	87/12/02	0.1594
Base B	206A1	BENZENE	0.7988	87/12/03	0.7988
Base B	206A1	BENZENE	0.0067	90/05/11	0.008
Base B	206A1	BENZENE	0.0878	90/05/11	0.1083
Base B	206A1	BENZENE	0.5708	90/05/11	0.7061
Base B	206A1	BENZENE	0.0081	90/05/11	0.0096
Base B	206A1	BENZENE	0.0086	90/05/14	0.0099
Base B	206A1	BENZENE	0.1202	90/05/14	0.1383
Base B	206A1	BENZENE		90/05/15	0.1492
Base B	206A1	BENZENE	0.1187	90/05/15	0.1492
Base B	206A1	BENZENE	0.7788	90/05/15	0.9812
Base B	206A1	BENZENE	0.0293	90/05/16	0.0702
Base B	206A1	BENZENE	0.0935	90/05/16	0.2222
Base B	206A1	BENZIN	0.0293	90/05/16	0.0702
Base B	206A1	JP-4 JET FUEL	3.4485	90/05/11	4.2552
Base B	206A1	JP-4 JET FUEL	65.0943	90/05/11	80.529
Base B	206A1	JP-4 JET FUEL	3.764	90/05/11	4.45
Base B	206A1	JP-4 JET FUEL	3.4727	90/05/11	4.1465
Base B	206A1	JP-4 JET FUEL	3.8308	90/05/14	4.4096
Base B	206A1	STODDARD SOLVENT	11.6	87/12/03	11.6
Base B	25C1	BENZENE	0.3522	91/03/07	0.3715
Base B	25C1	BENZENE	0.0108	91/03/07	0.2064
Base B	25C1	BENZENE	0.0125	91/03/07	0.2007
Base B	25C1	BENZENE	0.2572	91/03/07	8.2315
Base B	25C1	BENZENE	0.013	91/03/07	0.2086
Base B	25C1	BENZENE	0.0396	91/03/07	1.2688
Base B	25C1	BENZENE	0.0132	91/03/07	0.2109
Base B	25C1	BENZENE	0.02	91/03/07	0.3201
Base B	25C1	BENZENE	0.0142	91/03/07	0.2269
Base B	25C1	BENZENE	0.0135	91/03/07	0.2157
Base B	25C1	BENZENE	0.0095	91/03/07	0.1524
Base B	25C1	BENZENE	0.014	91/04/25	0.4483
Base B	25C1	BENZENE	0.032	91/05/21	0.032
Base B	25C1	BENZENE	0.03	91/05/21	0.03
Base B	25C1	BENZENE	0.1042	91/05/23	0.1042

Base B	25C1	BENZENE	0.112	91/05/23	0.1109
Base B	25C1	BENZENE	0.0307	91/05/24	0.0307
Base B	25C1	BENZENE	0.032	91/05/24	0.032
Base B	25C1	JP-4 JET FUEL	3.2136	91/03/07	51.418
Base B	25C1	JP-4 JET FUEL	37.7764	91/03/07	39.852
Base B	25C1	JP-4 JET FUEL	3.2139	91/03/07	61.706
Base B	25C1	JP-4 JET FUEL	3.1121	91/03/07	49.793
Base B	25C1	JP-4 JET FUEL	9.8019	91/03/07	313.66
Base B	25C1	JP-4 JET FUEL	3.1687	91/03/07	50.699
Base B	25C1	JP-4 JET FUEL	3.1121	91/03/07	99.586
Base B	25C1	JP-4 JET FUEL	3.2136	91/03/07	51.418
Base B	25C1	JP-4 JET FUEL	3.1121	91/03/07	49.793
Base B	25C1	JP-4 JET FUEL	3.1687	91/03/07	50.699
Base B	25C1	JP-4 JET FUEL	3.1121	91/03/07	49.793
Base B	25C1	JP-4 JET FUEL	3.2138	91/04/25	102.84
Base B	25C1	JP-4 JET FUEL	0.648	91/05/21	0.648
Base B	25C1	JP-4 JET FUEL	0.6419	91/05/21	0.6419
Base B	25C1	JP-4 JET FUEL	5.8584	91/05/23	5.798
Base B	25C1	JP-4 JET FUEL	3.7266	91/05/23	3.7266
Base B	25C1	JP-4 JET FUEL	0.614	91/05/24	0.614
Base B	25C1	JP-4 JET FUEL	0.642	91/05/24	0.642
Base B	25C1	METHANE, DICHLORODIFLUORO-	83.0598	91/06/05	1993.4
Base B	Z467	BENZENE	0.325		6.0007
Base B	Z467	BENZENE	0.1009		0.8073
Base B	Z467	BENZENE	0.1266		1.0127
Base B	Z467	BENZENE		88/05/20	0.2237
Base B	Z467	BENZENE		90/03/17	3.4101
Base B	Z467	BENZENE		90/03/17	0.5371
Base B	Z467	BENZENE		90/03/17	
Base B	Z467	BENZENE		90/03/17	1.1496
Base B	Z467	BENZENE	0	95/02/14	0
Base B	Z467	BENZENE	0	95/02/17	0
Base B	Z467	BENZENE	0	95/02/17	0
Base B	Z467	BENZENE	0	95/02/17	0
Base B	Z467	BENZENE	0.325	95/03/27	6.0007
Base B	Z467	BENZENE	0.0068	95/03/27	0.1412
Base B	Z467	BENZENE	0.1198	95/03/27	1.5544
Base B	Z467	BENZENE	0.0883	95/03/27	1.1774
Base B	Z467	BENZENE	0.0018	95/03/27	0.0134
Base B	Z467	BENZENE	0.0284	95/03/27	0.4016
Base B	Z467	BENZENE	0.0126	95/03/27	0.2521
Base B	Z467	JP-4 JET FUEL	9.0642		72.513
Base B	Z467	JP-4 JET FUEL	6.2325		49.86
Base B	Z467	JP-4 JET FUEL	18.85		348
Base B	Z467	JP-4 JET FUEL	0	95/02/14	0
Base B	Z467	JP-4 JET FUEL	0	95/02/17	0
Base B	Z467	JP-4 JET FUEL	0	95/02/17	0
Base B	Z467	JP-4 JET FUEL	0	95/02/17	0
Base B	Z467	JP-4 JET FUEL	18.85	95/03/27	348
Base B	Z467	JP-4 JET FUEL		95/03/27	
Base B	Z467	JP-4 JET FUEL	9.0642	95/03/27	117.59

Base B	Z467	JP-4 JET FUEL	6.2325	95/03/27	83.1
Base B	Z467	JP-4 JET FUEL		95/03/27	
Base B	Z467	JP-4 JET FUEL	3.8073	95/03/27	53.75
Base B	Z467	JP-4 JET FUEL		95/03/27	
Base B	Z425	BENZENE		89/07/21	0
Base B	Z425	BENZENE	0	89/07/21	0
Base B	Z425	BENZENE		90/02/22	0.5
Base B	Z425	BENZENE	0.0052	90/02/22	0.0581
Base B	Z425	BENZENE	0.0052	90/02/22	0.0417
Base B	Z425	BENZENE	1.0154	91/04/05	2.7078
Base B	Z425	BENZENE	0.8201	91/04/05	2.4602
Base B	Z425	DIESEL FUELS	132	91/04/05	352
Base B	Z425	DIESEL FUELS	100.3333	91/04/05	301
Base B	Z425	STODDARD SOLVENT		89/07/21	
Base B	Z425	STODDARD SOLVENT	0	89/07/21	0
Base B	Z150	BENZENE	0.0283	89/10/11	0.1598
Base B	Z150	BENZENE	0.0283	89/10/11	0.1598
Base B	Z150	BENZENE	0.0283	89/10/11	0.1598
Base B	Z150	BENZENE	0.0981	91/05/07	1.207
Base B	Z150	BENZENE	0.0262	91/05/07	0.4195
Base B	Z150	BENZENE	0.1173	91/05/07	1.482
Base B	Z150	JP-4 JET FUEL	5.3125	89/10/11	30
Base B	Z150	JP-4 JET FUEL	5.3125	89/10/11	30
Base B	Z150	JP-4 JET FUEL	5.3125	89/10/11	30
Base B	Z150	JP-4 JET FUEL	9.3451	91/05/07	118.04
Base B	Z150	JP-4 JET FUEL	6.957	91/05/07	85.624
Base B	Z150	JP-4 JET FUEL	1.9493	91/05/07	31.188
Base B	Z10	BENZENE	0	91/03/11	0
Base B	Z10	BENZENE	0	91/03/11	0
Base B	Z10	BENZENE	0.0201	92/04/29	0.1137
Base B	Z10	BENZENE	0	92/04/29	0
Base B	Z10	BENZENE	0.0166	92/04/29	0.0591
Base B	Z10	BENZENE	0.0161	92/04/29	0.0572
Base B	Z10	BENZENE	0.0172	92/04/29	0.1032
Base B	Z10	BENZENE	0.0071	92/04/29	0.0975
Base B	Z10	BENZENE	0.0077	92/04/29	0.1061
Base B	Z10	BENZENE	0.003	92/04/29	0.0208
Base B	Z10	ETHANOL, 2-METHOXY-	0	91/03/11	0
Base B	Z10	ETHANOL, 2-METHOXY-	0	91/03/11	0
Base B	Z10	HEXANE	0	91/03/11	0
Base B	Z10	HEXANE	0	91/03/11	0
Base B	Z10	JP-4 JET FUEL	1.2635	92/04/29	4.4923
Base B	Z10	JP-4 JET FUEL	0.7409	92/04/29	4.4455
Base B	Z10	JP-4 JET FUEL	1.1576	92/04/29	4.1158
Base B	Z10	JP-4 JET FUEL	0.9551	92/04/29	5.3933
Base B	Z10	JP-4 JET FUEL	0.1583	92/04/29	2.1714
Base B	Z10	JP-4 JET FUEL	0.2727	92/04/29	3.74
Base B	Z10	JP-4 JET FUEL	0.2558	92/04/29	1.7538
Base B	Z10	JP-4 JET FUEL	0.1283	92/04/29	0.88
Base B	Z10	2,4-PENTANEDIOL, 1-(3-FURANY	7.2917	91/03/11	28
Base B	Z10	2,4-PENTANEDIOL, 1-(3-FURANY	4.875	91/03/11	36

Base B	Z10	2,4-PENTANEDIOL, 1-(3-FURANY		91/06/28	
Base B	Z10	2,4-PENTANEDIOL, 1-(3-FURANY		91/06/28	
Base B	Z10	2,4-PENTANEDIOL, 1-(3-FURANY		91/06/28	
Base B	Z10	PETROLEUM DISTILLATE	14.0625	92/03/12	90
Base B	Z10	XYLENE	0	91/03/11	0
Base B	Z10	XYLENE	0	91/03/11	0
Base B	Z136	BENZENE	0.0987	91/04/01	0.474
Base B	Z136	BENZENE	0.0452	91/04/01	0.2172
Base B	Z136	BENZENE	0.013	91/04/01	0.0626
Base B	Z136	BENZENE	0.0419	91/04/01	0.2233
Base B	Z136	BENZENE	0.3247	91/04/01	1.2081
Base B	Z136	BENZENE	0.4215	91/04/01	1.6186
Base B	Z136	BENZENE	0.0394	91/04/01	0.1512
Base B	Z136	BENZENE	0.0193	91/04/01	0.0711
Base B	Z136	BENZENE	0.1513	91/04/02	0.1614
Base B	Z136	BENZENE	0.7499	91/04/02	0.7499
Base B	Z136	BENZENE	0.3505	91/04/03	0.3505
Base B	Z136	BENZENE	0.5352	91/04/03	0.5524
Base B	Z136	BENZENE	0.2136	91/04/03	0.2205
Base B	Z136	BENZENE	0.0847	91/04/04	0.0856
Base B	Z136	BENZENE	0.0895	91/04/04	0.0895
Base B	Z136	BENZENE	0.0665	91/09/12	0.6387
Base B	Z136	BENZENE	0.0326	91/09/12	0.8234
Base B	Z136	BENZENE	0.0789	91/09/12	0.8061
Base B	Z136	BENZENE	0.0431	91/09/12	0.9841
Base B	Z136	JP-4 JET FUEL	3.1687	91/04/01	11.7
Base B	Z136	JP-4 JET FUEL	3.5394	91/04/01	16.989
Base B	Z136	JP-4 JET FUEL	3.1667	91/04/01	15.2
Base B	Z136	JP-4 JET FUEL	3.1667	91/04/01	15.2
Base B	Z136	JP-4 JET FUEL	3.225	91/04/01	17.2
Base B	Z136	JP-4 JET FUEL	11.8376	91/04/01	44.047
Base B	Z136	JP-4 JET FUEL	17.3576	91/04/01	66.653
Base B	Z136	JP-4 JET FUEL	3.2292	91/04/01	12.4
Base B	Z136	JP-4 JET FUEL	7.1649	91/04/02	7.6426
Base B	Z136	JP-4 JET FUEL	32.214	91/04/02	32.214
Base B	Z136	JP-4 JET FUEL	26.095	91/04/03	26.095
Base B	Z136	JP-4 JET FUEL	14.0953	91/04/03	14.55
Base B	Z136	JP-4 JET FUEL	31.7498	91/04/03	32.774
Base B	Z136	JP-4 JET FUEL	6.8199	91/04/04	6.8199
Base B	Z136	JP-4 JET FUEL	6.299	91/04/04	6.3653
Base B	Z136	JP-4 JET FUEL	0.0542	91/09/12	0.52
Base B	Z136	JP-4 JET FUEL	0.0079	91/09/12	0.2
Base B	Z136	JP-4 JET FUEL	3.0201	91/09/12	30.843
Base B	Z136	JP-4 JET FUEL	1.7301	91/09/12	39.545
Base B	Z329			91/03/26	
Base B	Z329			91/03/26	
Base B	Z329			91/03/27	
Base B	Z329	BENZENE	0.0231	91/03/26	0.054
Base B	Z329	BENZENE	0.0249	91/03/26	0.057
Base B	Z329	BENZENE		91/05/17	
Base B	Z329	UST, NUISANCE, TOTAL	0.1562	91/03/27	1

Base B	Z329	CADMIUM	0.0001	93/11/18	0.0001
Base B	Z329	ETHANE, 1,1,1-TRICHLORO	10.5031	89/11/14	18.672
Base B	Z329	ETHANE, 1,1,1-TRICHLORO	11.197	89/11/14	19.905
Base B	Z329	JP-4 JET FUEL	12.5562	91/03/26	29.4
Base B	Z329	JP-4 JET FUEL	12.5563	91/03/26	28.7
Base B	Z329	JP-4 JET FUEL	0.2888	91/05/17	9.2428
Base B	Z408	BENZENE	0.1502	92/09/28	1.0605
Base B	Z408	BENZENE	0.4101	92/09/28	2.8526
Base B	Z408	BENZENE	0.042	92/09/28	0.3099
Base B	Z408	JP-4 JET FUEL	2.1073	92/09/28	15.561
Base B	Z408	JP-4 JET FUEL	7.7191	92/09/28	54.487
Base B	Z408	JP-4 JET FUEL	19.3394	92/09/28	134.53
Base B	Z484	BENZENE	12.7087		62.246
Base B	Z484	BENZENE	1.8918		9.1721
Base B	Z484	BENZENE	0.3834	89/06/14	0.5751
Base B	Z484	BENZENE	0.0193	89/06/14	0.0639
Base B	Z484	BENZENE	0.1278	89/06/14	0.1917
Base B	Z484	BENZENE	1.7706	89/06/14	2.2366
Base B	Z484	BENZENE	3.5412	89/06/14	4.4731
Base B	Z484	BENZENE		90/01/18	0
Base B	Z484	BENZENE		90/01/18	0
Base B	Z484	BENZENE	0.6855	90/02/16	1.4822
Base B	Z484	BENZENE	0.2561	90/02/16	0.5614
Base B	Z484	BENZENE	0.8261	90/02/16	1.7241
Base B	Z484	BENZENE		91/02/13	
Base B	Z484	BENZENE		91/02/13	
Base B	Z484	BENZENE		91/02/13	
Base B	Z484	BENZENE	0.2451	91/03/14	0.6537
Base B	Z484	BENZENE	0.1156	91/03/14	0.2176
Base B	Z484	BENZENE	3.2966	91/03/14	8.3283
Base B	Z484	BENZENE	0.2782	91/03/14	0.7029
Base B	Z484	BENZENE	0.0954	91/03/14	0.1796
Base B	Z484	BENZENE	2.2607	91/03/14	4.429
Base B	Z484	BENZENE	0.508	91/03/14	0.548
Base B	Z484	BENZENE	3.3739	91/03/14	3.7229
Base B	Z484	BENZENE	0.5077	91/11/12	0.8432
Base B	Z484	BENZENE	0.4615	94/08/31	4.4306
Base B	Z484	BENZENE	1.0179	94/08/31	9.3958
Base B	Z484	BENZENE	0.3681	94/09/01	3.5341
Base B	Z484	BENZENE	0.2021	94/09/01	1.98
Base B	Z484	BENZENE	6.3544	94/09/01	62.246
Base B	Z484	BENZENE	1.5236	94/09/01	14.925
Base B	Z484	2-BUTANONE		91/02/13	
Base B	Z484	2-BUTANONE		91/02/13	
Base B	Z484	2-BUTANONE		91/02/13	
Base B	Z484	ETHANE, 1,1,1-TRICHLORO	27.019	90/01/29	40.028
Base B	Z484	ETHANE, 1,1,1-TRICHLORO	17.2196	90/01/29	25.669
Base B	Z484	GASOLINE	38.5993	90/02/16	83.458
Base B	Z484	GASOLINE	14.3846	90/02/16	31.528
Base B	Z484	GASOLINE	49.4213	90/02/16	103.14
Base B	Z484	JP-4 JET FUEL	402.6779		1972.3

Base B	Z484	JP-4 JET FUEL	52.1596		252.89
Base B	Z484	JP-4 JET FUEL	7.5333	89/06/14	11.3
Base B	Z484	JP-4 JET FUEL	1.0875	89/06/14	3.6
Base B	Z484	JP-4 JET FUEL	2	89/06/14	3
Base B	Z484	JP-4 JET FUEL	45.0458	89/06/14	56.9
Base B	Z484	JP-4 JET FUEL	101.3333	89/06/14	128
Base B	Z484	JP-4 JET FUEL		90/01/18	11.907
Base B	Z484	JP-4 JET FUEL		90/01/18	10.865
Base B	Z484	JP-4 JET FUEL	4.2988	90/02/16	9.2946
Base B	Z484	JP-4 JET FUEL	4.0071	90/02/16	8.3627
Base B	Z484	JP-4 JET FUEL	4.0221	90/02/16	8.8156
Base B	Z484	JP-4 JET FUEL	3.3923	91/03/14	6.3856
Base B	Z484	JP-4 JET FUEL	70.2486	91/03/14	137.63
Base B	Z484	JP-4 JET FUEL	145.0906	91/03/14	160.1
Base B	Z484	JP-4 JET FUEL	4.353	91/03/14	8.1938
Base B	Z484	JP-4 JET FUEL	48.2083	91/03/14	52
Base B	Z484	JP-4 JET FUEL	8.0554	91/03/14	21.481
Base B	Z484	JP-4 JET FUEL	112.4642	91/03/14	284.12
Base B	Z484	JP-4 JET FUEL	6.8906	94/08/31	66.15
Base B	Z484	JP-4 JET FUEL	15.301	94/08/31	141.24
Base B	Z484	JP-4 JET FUEL	5.2884	94/09/01	51.805
Base B	Z484	JP-4 JET FUEL	201.339	94/09/01	1972.3
Base B	Z484	JP-4 JET FUEL	40.668	94/09/01	398.38
Base B	Z484	JP-4 JET FUEL	11.4917	94/09/01	110.32
Base B	Z484	TOLUENE	0.6531	90/01/29	0.9735
Base B	Z484	TOLUENE	0.7998	90/01/29	1.1849
Base B	Z484	XYLENE	0	90/01/29	0
Base B	Z484	XYLENE	0	90/01/29	0
Base B	Z486	ACETIC ACID, ETHYL ESTER	1.7776	92/04/30	13.761
Base B	Z486	ACETIC ACID, ETHYL ESTER	9.7196	92/04/30	71.775
Base B	Z486	ACETIC ACID, ISOBUTYL ESTER	0.0623	92/04/30	0.46
Base B	Z486	ACETIC ACID, ISOBUTYL ESTER	0.062	92/04/30	0.48
Base B	Z486	BENZENE	0.0019	92/04/30	0.1
Base B	Z486	BENZENE	0.0344	92/04/30	1.8337
Base B	Z486	BENZENE	0.0175	92/05/05	0.02
Base B	Z486	BENZENE	0.1876	92/05/05	0.1987
Base B	Z486	BENZENE	0.0058	93/08/10	0.198
Base B	Z486	BENZENE	0.2762	93/08/10	9.4703
Base B	Z486	BENZENE	0.0271	94/02/16	0.2601
Base B	Z486	BENZENE	0.0448	94/02/16	0.4301
Base B	Z486	BUTYL ALCOHOL	0.0675	92/04/30	0.4982
Base B	Z486	ISOBUTYL ALCOHOL	0.062	92/04/30	0.48
Base B	Z486	ISOPROPYL ALCOHOL	0.0934	92/04/30	0.69
Base B	Z486	ISOPROPYL ALCOHOL	0.0943	92/04/30	0.73
Base B	Z486	JP-4 JET FUEL	3.15	92/04/30	168
Base B	Z486	JP-4 JET FUEL	3.15	92/04/30	168
Base B	Z486	JP-4 JET FUEL	37.7146	92/05/05	43
Base B	Z486	JP-4 JET FUEL	38.0331	92/05/05	40.3
Base B	Z486	JP-4 JET FUEL	3.1515	93/08/10	108.05
Base B	Z486	JP-4 JET FUEL	17.9959	93/08/10	617
Base B	Z486	JP-4 JET FUEL	3.3917	94/02/16	32.56

Base B	Z486	JP-4 JET FUEL	4.2271	94/02/16	40.58
Base B	Z486	STODDARD SOLVENT	3.9913	92/04/30	29.474
Base B	Z486	STODDARD SOLVENT	1.9763	92/04/30	15.3
Base B	Z486	TOLUENE	0.031	92/04/30	0.24
Base B	Z486	TOLUENE	0.3709	92/04/30	2.7389
Base B	225F2	BENZENE	0.0191	91/09/12	0.3978
Base B	225F2	CADMIUM	0.0001	93/11/30	0.0001
Base B	225F2	JP-4 JET FUEL	5.9048	91/09/12	123.23
Base B	225I2			91/07/10	
Base B	225I2	BENZENE	0.0569	91/07/10	0.1115
Base B	225I2	BENZENE	0.0288	91/07/10	0.0613
Base B	225I2	BENZENE	0.0929	91/07/10	0.1981
Base B	225I2	BENZENE		91/07/10	
Base B	225I2	BENZENE	0.0537	91/07/10	0.1096
Base B	225I2	BENZENE	0.0015	91/07/10	0.0029
Base B	225I2	BENZENE	0.0015	91/08/13	0.0099
Base B	225I2	BENZENE	0.1327	91/09/12	0.6502
Base B	225I2	BENZENE	0.0209	91/09/12	0.032
Base B	225I2	BENZENE	0.0045	91/09/12	0.0147
Base B	225I2	BENZENE	0.2271	91/09/12	1.0898
Base B	225I2	BENZENE	0.0563	91/09/12	0.3553
Base B	225I2	BENZENE	0.0372	91/09/12	0.4058
Base B	225I2	BENZENE	0.0251	91/09/12	0.1939
Base B	225I2	BENZENE	0.0202	91/09/12	0.215
Base B	225I2	BENZENE	0.0723	91/09/12	0.5182
Base B	225I2	BENZENE	0.0109	91/09/12	0.209
Base B	225I2	BENZENE	0.6185	91/09/12	3.9587
Base B	225I2	BENZENE	0.0236	91/09/12	0.4364
Base B	225I2	BENZENE	0.0269	91/09/12	0.1093
Base B	225I2	BENZENE	0.013	91/09/12	0.2709
Base B	225I2	BENZENE	0.0309	91/09/13	0.247
Base B	225I2	BENZENE	0.0525	91/09/13	0.4198
Base B	225I2	BENZENE	0.1413	92/08/22	0.6224
Base B	225I2	BENZENE	0.333	92/08/22	1.5081
Base B	225I2	BENZENE	0.3328	92/08/22	1.4793
Base B	225I2	BENZENE	0.3327	92/08/22	1.5209
Base B	225I2	BENZENE	0.3328	92/08/22	1.4793
Base B	225I2	BENZENE	0.3325	92/08/22	1.4122
Base B	225I2	BENZENE	0.3328	92/08/22	1.4793
Base B	225I2	BENZENE	0.333	92/08/22	1.5081
Base B	225I2	BENZENE	0.1886	92/08/24	2.1052
Base B	225I2	BENZENE	0.2497	92/08/24	3.0727
Base B	225I2	BENZENE	11.7611	92/08/24	156.81
Base B	225I2	BENZENE	8.879	92/08/24	129.14
Base B	225I2	BENZENE	0.5372	92/08/24	6.6116
Base B	225I2	BENZENE	0.3492	92/08/24	4.53
Base B	225I2	JP-4 JET FUEL	0.498	91/08/13	3.23
Base B	225I2	JP-4 JET FUEL	2.4335	91/09/12	3.72
Base B	225I2	JP-4 JET FUEL	28.5833	91/09/12	137.2
Base B	225I2	JP-4 JET FUEL	10.7919	91/09/12	83.55
Base B	225I2	JP-4 JET FUEL	2636.087	91/09/12	55014

Base B	225I2	JP-4 JET FUEL	1.1485	91/09/12	5.6252
Base B	225I2	JP-4 JET FUEL	12.0771	91/09/12	231.88
Base B	225I2	JP-4 JET FUEL	2.6827	91/09/12	8.76
Base B	225I2	JP-4 JET FUEL	28.8828	91/09/12	184.85
Base B	225I2	JP-4 JET FUEL	19.038	91/09/12	120.24
Base B	225I2	JP-4 JET FUEL	15.3771	91/09/12	167.75
Base B	225I2	JP-4 JET FUEL	2.8566	91/09/12	11.62
Base B	225I2	JP-4 JET FUEL	6.7538	91/09/12	72.04
Base B	225I2	JP-4 JET FUEL	28.1051	91/09/12	201.35
Base B	225I2	JP-4 JET FUEL	2.6423	91/09/12	48.78
Base B	225I2	JP-4 JET FUEL	11.5026	91/09/13	92.02
Base B	225I2	JP-4 JET FUEL	9.0312	91/09/13	72.25
Base B	225I2	JP-4 JET FUEL	4.1976	92/08/22	19.008
Base B	225I2	JP-4 JET FUEL	3.2545	92/08/22	14.464
Base B	225I2	JP-4 JET FUEL	3.1249	92/08/22	13.274
Base B	225I2	JP-4 JET FUEL	17.7041	92/08/22	78.684
Base B	225I2	JP-4 JET FUEL	3.1251	92/08/22	14.286
Base B	225I2	JP-4 JET FUEL	4.7339	92/08/22	20.846
Base B	225I2	JP-4 JET FUEL	18.8182	92/08/22	85.214
Base B	225I2	JP-4 JET FUEL	3.9085	92/08/24	50.704
Base B	225I2	JP-4 JET FUEL	8.3958	92/08/24	103.33
Base B	225I2	JP-4 JET FUEL	132.9384	92/08/24	1933.6
Base B	225I2	JP-4 JET FUEL	3.1247	92/08/24	34.88
Base B	225I2	JP-4 JET FUEL	3.1249	92/08/24	38.46
Base B	225I2	JP-4 JET FUEL	139.4062	92/08/24	1858.7
Base B	225I2	JP-4 JET FUEL			
Base B	225I2	BENZENE			0.0791
Base B	225I2	JP-4 JET FUEL			
Base B	225I2	BENZENE			0.8632
Base B	225I2	JP-4 JET FUEL			22.46
Base B	225N1			92/03/31	
Base B	225N1	BENZENE	0.0066	90/06/22	0.0256
Base B	225N1	BENZENE	0.2576	90/06/22	0.2924
Base B	225N1	BENZENE	0.0063	92/03/31	0.1598
Base B	225N1	BENZENE	0.007	92/03/31	0.0959
Base B	225N1	BENZENE	0.063	94/05/17	1.0793
Base B	225N1	BENZENE	0.092	94/05/17	1.7666
Base B	225N1	BENZENE	0.0813	94/05/17	1.4455
Base B	225N1	BENZENE	0.0585	94/05/17	0.9678
Base B	225N1	BENZENE	0.0069	94/05/31	0.1
Base B	225N1	BENZENE	0.0148	94/05/31	0.2291
Base B	225N1	BENZENE	0.0063	94/05/31	0.101
Base B	225N1	ETHANE, 1,1,1-TRICHLORO	0.0391	90/06/22	0.1528
Base B	225N1	ETHANE, 1,1,1-TRICHLORO	2.0348	90/06/22	2.309
Base B	225N1	JP-4 JET FUEL	81.2512	90/06/22	92.2
Base B	225N1	JP-4 JET FUEL	0.7298	90/06/22	2.848
Base B	225N1	JP-4 JET FUEL	0.5209	92/03/31	13.16
Base B	225N1	JP-4 JET FUEL	0.5206	92/03/31	7.14
Base B	225N1	JP-4 JET FUEL	3.2773	94/05/31	47.67
Base B	225N1	JP-4 JET FUEL	3.1368	94/05/31	48.57
Base B	225N1	JP-4 JET FUEL	3.8138	94/05/31	61.02

Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0417	91/04/02	0.2532
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0417	91/04/02	0.1869
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0417	91/04/02	0.3636
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0198	94/01/25	0.1671
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/25	0.0203
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/25	0.0826
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/25	0.1613
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0198	94/01/25	0.1587
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0198	94/01/25	0.0768
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/25	0.1724
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0198	94/01/25	0.216
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0207	94/01/25	0.166
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/25	0.125
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0198	94/01/25	0.122
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0198	94/01/25	0.1488
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/25	0.204
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/26	0.1724
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/26	0.185
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.0208	94/01/26	0.185
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.1507	94/10/19	0.3244
Base B	225P1	ACETIC ACID, ETHYL ESTER	0.339	94/10/19	0.7569
Base B	225P1	BENZENE	1.8905	91/04/29	2.0576
Base B	225P1	BENZENE	0.4337	91/05/01	0.5016
Base B	225P1	BENZENE	0.1778	91/05/01	0.8052
Base B	225P1	BENZENE	0.0154	92/01/28	0.038
Base B	225P1	BENZENE	0.1886	92/01/28	3.3523
Base B	225P1	BENZENE	0.3907	92/01/28	6.4662
Base B	225P1	BENZENE	0.2135	92/01/28	0.9668
Base B	225P1	BENZENE	6.3715	92/01/28	4.144
Base B	225P1	BENZENE	0.0238	94/01/25	0.2007
Base B	225P1	BENZENE	0.0624	94/01/25	0.061
Base B	225P1	BENZENE	0.8503	94/01/25	6.8024
Base B	225P1	BENZENE	0.0211	94/01/25	0.163
Base B	225P1	BENZENE	0.0208	94/01/25	0.125
Base B	225P1	BENZENE	0.0207	94/01/25	0.166
Base B	225P1	BENZENE	0.0531	94/01/25	0.5205
Base B	225P1	BENZENE	0.0198	94/01/25	0.0765
Base B	225P1	BENZENE	0.0208	94/01/25	0.1724
Base B	225P1	BENZENE	0.1965	94/01/25	2.1433
Base B	225P1	BENZENE	0.248	94/01/25	1.5263
Base B	225P1	BENZENE	0.0734	94/01/25	0.5505
Base B	225P1	BENZENE	0.0208	94/01/25	0.0826
Base B	225P1	BENZENE	0.0208	94/01/26	0.1724
Base B	225P1	BENZENE	0.0708	94/01/26	0.6298
Base B	225P1	BENZENE	0.0208	94/01/26	0.185
Base B	225P1	BENZENE		94/02/04	0.05
Base B	225P1	BENZENE	0.0446	94/02/04	0.1984
Base B	225P1	BENZENE	0.0208	94/02/04	0.2502
Base B	225P1	BENZENE	0.0208	94/02/04	0.096
Base B	225P1	BENZENE	0.1615	94/02/04	1.8905
Base B	225P1	BENZENE	0.0211	94/02/07	0.26

Base B	225P1	BENZENE	0.0217	94/02/07	0.26
Base B	225P1	BENZENE	0.199	94/02/07	2.449
Base B	225P1	BENZIN	0.3167	91/04/02	2.7636
Base B	225P1	BENZIN	5.649	91/04/02	34.323
Base B	225P1	BENZIN	1.7958	91/04/02	8.0561
Base B	225P1	2-BUTANONE	2.2039	91/04/02	10.27
Base B	225P1	2-BUTANONE	1.0647	91/04/02	10.43
Base B	225P1	2-BUTANONE	9.4701	91/04/02	92.767
Base B	225P1	2-BUTANONE	2.616	94/10/19	5.8404
Base B	225P1	2-BUTANONE	2.4941	94/10/19	5.3684
Base B	225P1	2-BUTANONE	9.8708	95/01/26	25.336
Base B	225P1	2-BUTANONE	7.6251	95/01/26	19.468
Base B	225P1	CADMIUM	0.0067	93/11/12	0.0074
Base B	225P1	CADMIUM	0.001	93/11/16	0.0011
Base B	225P1	CADMIUM	0.0107	93/11/16	0.012
Base B	225P1	CADMIUM	0.0033	93/11/16	0.0034
Base B	225P1	CADMIUM	0.0019	93/11/18	0.0019
Base B	225P1	CADMIUM	0.0004	93/11/18	0.0004
Base B	225P1	CADMIUM	0.015	93/12/01	0.0157
Base B	225P1	CADMIUM	0.0112	93/12/01	0.0121
Base B	225P1	CADMIUM	0.0101	93/12/01	0.286
Base B	225P1	CADMIUM	0	93/12/01	0
Base B	225P1	CADMIUM	0.0002	93/12/01	0.0006
Base B	225P1	CADMIUM	0.0975	93/12/02	0.112
Base B	225P1	CADMIUM	0.004	93/12/02	0.0491
Base B	225P1	CADMIUM	0.0112	93/12/02	0.0114
Base B	225P1	CADMIUM	0.0764	93/12/02	0.47
Base B	225P1	CADMIUM	0.005	95/01/26	0.0128
Base B	225P1	CADMIUM	0.0019	95/01/26	0.0049
Base B	225P1	ETHANE, 1,1,1-TRICHLORO	3.2784	91/04/03	41.411
Base B	225P1	ETHANE, 1,1,1-TRICHLORO	0.6991	91/04/03	13.421
Base B	225P1	ETHANE, 1,1,1-TRICHLORO	0.6236	91/04/03	11.512
Base B	225P1	ETHANE, 1,1,1-TRICHLORO	2.004	94/10/19	4.4739
Base B	225P1	ETHANE, 1,1,1-TRICHLORO	2.5094	94/10/19	5.4015
Base B	225P1	ETHANE, 1,1,1-TRICHLORO	8.0153	95/01/26	20.464
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	17.3638	94/01/25	16.974
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	4.9633	94/01/25	41.795
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	2.4365	94/01/25	19.492
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	1.5677	94/01/25	15.357
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	3.8046	94/01/25	14.727
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	1.8055	94/01/25	19.696
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	2.5573	94/01/25	20.458
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	2.4311	94/01/25	18.233
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	0.7844	94/01/25	4.7064
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	4.5333	94/01/25	37.517
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	2.7331	94/01/25	16.819
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	1.3042	94/01/25	10.096
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	3.8959	94/01/25	15.454
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	0.1419	94/01/26	1.174
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	1.3635	94/01/26	12.12
Base B	225P1	ETHANE, 1,1,2-TRICHLORO-	1.1896	94/01/26	10.574

Base B	225P1	ISOPROPYL ALCOHOL	0.0417	91/04/02	0.1869
Base B	225P1	ISOPROPYL ALCOHOL	0.8489	91/04/02	5.1579
Base B	225P1	ISOPROPYL ALCOHOL	0.0417	91/04/02	0.3636
Base B	225P1	JP-4 JET FUEL	213.6921	91/04/29	232.59
Base B	225P1	JP-4 JET FUEL	32.0458	91/05/01	37.065
Base B	225P1	JP-4 JET FUEL	8.6693	91/05/01	39.257
Base B	225P1	JP-4 JET FUEL	3.1769	92/01/28	7.82
Base B	225P1	JP-4 JET FUEL	373.2281	92/01/28	242.75
Base B	225P1	JP-4 JET FUEL	24.5159	92/01/28	405.78
Base B	225P1	JP-4 JET FUEL	9.4969	92/01/28	43.005
Base B	225P1	JP-4 JET FUEL	12.5134	92/01/28	222.46
Base B	225P1	JP-4 JET FUEL	1.8254	94/01/25	7.066
Base B	225P1	JP-4 JET FUEL	2.3036	94/01/25	14.176
Base B	225P1	JP-4 JET FUEL	12.1091	94/01/25	96.873
Base B	225P1	JP-4 JET FUEL	1.9166	94/01/25	15.333
Base B	225P1	JP-4 JET FUEL	2.496	94/01/25	27.229
Base B	225P1	JP-4 JET FUEL	2.6063	94/01/25	2.5479
Base B	225P1	JP-4 JET FUEL	1.9166	94/01/25	7.603
Base B	225P1	JP-4 JET FUEL	1.9559	94/01/25	19.16
Base B	225P1	JP-4 JET FUEL	0.0104	94/01/25	0.086
Base B	225P1	JP-4 JET FUEL	1.9166	94/01/25	14.838
Base B	225P1	JP-4 JET FUEL	1.8254	94/01/25	15.372
Base B	225P1	JP-4 JET FUEL	1.7153	94/01/25	12.865
Base B	225P1	JP-4 JET FUEL	1.9167	94/01/25	11.5
Base B	225P1	JP-4 JET FUEL	1.9167	94/01/26	15.862
Base B	225P1	JP-4 JET FUEL	1.9167	94/01/26	17.037
Base B	225P1	JP-4 JET FUEL	1.9167	94/01/26	17.037
Base B	225P1	JP-4 JET FUEL		94/02/04	6.2
Base B	225P1	JP-4 JET FUEL	8.084	94/02/04	35.929
Base B	225P1	JP-4 JET FUEL	2.7291	94/02/04	12.596
Base B	225P1	JP-4 JET FUEL	0.675	94/02/04	8.1
Base B	225P1	JP-4 JET FUEL	6.8562	94/02/04	80.268
Base B	225P1	JP-4 JET FUEL	2.7292	94/02/07	33.59
Base B	225P1	JP-4 JET FUEL	8.3241	94/02/07	102.45
Base B	225P1	JP-4 JET FUEL	2.8667	94/02/07	34.4
Base B	225P1	KEROSENE	29.355	91/04/29	31.951
Base B	225P1	KEROSENE	18.7839	91/05/01	21.726
Base B	225P1	KEROSENE	3.75	91/05/01	16.981
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0598	91/04/02	0.3636
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0417	91/04/02	0.1869
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0417	91/04/02	0.3636
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.2818	94/01/25	2.254
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0555	94/01/25	0.3417
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0782	94/01/25	0.0764
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0565	94/01/25	0.6169
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0312	94/01/25	0.306
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0094	94/01/25	0.0365
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0312	94/01/25	0.258
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.1002	94/01/25	0.7516
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0416	94/01/25	0.165
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0312	94/01/25	0.25

Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0516	94/01/25	0.4345
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0208	94/01/25	0.1613
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0312	94/01/25	0.1875
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0312	94/01/26	0.2586
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0542	94/01/26	0.4814
Base B	225P1	PROPANE, 1-CHLORO-2,3-EPOXY-	0.0312	94/01/26	0.2777
Base B	225P1	TOLUENE	0.0569	92/01/28	0.14
Base B	225P1	TOLUENE	0.1656	92/01/28	0.75
Base B	225P1	TOLUENE	0.1292	92/01/28	2.2964
Base B	225P1	TOLUENE	7.1536	92/01/28	4.6527
Base B	225P1	TOLUENE	0.2625	92/01/28	4.3448
Base B	225P1	TOLUENE	0.8899	94/01/25	7.1191
Base B	225P1	TOLUENE	0.2406	94/01/25	0.2352
Base B	225P1	TOLUENE	0.6676	94/01/25	4.1085
Base B	225P1	TOLUENE	0.4921	94/01/25	5.3681
Base B	225P1	TOLUENE	0.119	94/01/25	0.8929
Base B	225P1	TOLUENE	0.0794	94/01/25	0.3072
Base B	225P1	TOLUENE	0.0208	94/01/25	0.1724
Base B	225P1	TOLUENE	0.0573	94/01/25	0.2273
Base B	225P1	TOLUENE	0.149	94/01/25	1.4593
Base B	225P1	TOLUENE	0.0476	94/01/25	0.401
Base B	225P1	TOLUENE	0.0292	94/01/25	0.2258
Base B	225P1	TOLUENE	0.0344	94/01/25	0.2751
Base B	225P1	TOLUENE	0.0208	94/01/25	0.125
Base B	225P1	TOLUENE	0.0208	94/01/26	0.1724
Base B	225P1	TOLUENE	0.0315	94/01/26	0.28
Base B	225P1	TOLUENE	0.2177	94/01/26	1.9353
Base B	225P1	XYLENE	0.0569	92/01/28	0.14
Base B	225P1	XYLENE	0.3208	92/01/28	5.3103
Base B	225P1	XYLENE	0.3854	92/01/28	1.7453
Base B	225P1	XYLENE	0.1104	92/01/28	1.9629
Base B	225P1	XYLENE	15.1113	92/01/28	9.8285
Base B	225P1	XYLENE	0.0774	94/01/25	0.5802
Base B	225P1	XYLENE	0.1146	94/01/25	0.112
Base B	225P1	XYLENE	0.243	94/01/25	1.4956
Base B	225P1	XYLENE	0.0521	94/01/25	0.5103
Base B	225P1	XYLENE	0.0218	94/01/25	0.1837
Base B	225P1	XYLENE	0.0442	94/01/25	0.3422
Base B	225P1	XYLENE	0.0208	94/01/25	0.0826
Base B	225P1	XYLENE	0.1954	94/01/25	2.1319
Base B	225P1	XYLENE	0.4077	94/01/25	3.2618
Base B	225P1	XYLENE	0.0228	94/01/25	0.0882
Base B	225P1	XYLENE	0.0208	94/01/25	0.1724
Base B	225P1	XYLENE	0.0208	94/01/25	0.125
Base B	225P1	XYLENE	0.0207	94/01/25	0.166
Base B	225P1	XYLENE	0.0208	94/01/26	0.1724
Base B	225P1	XYLENE	0.0208	94/01/26	0.185
Base B	225P1	XYLENE	0.1052	94/01/26	0.935
Base B	225P1	ZINC OXIDE	0.001	94/10/19	0.0021
Base B	225Q1			92/05/26	
Base B	225Q1	ACETIC ACID, BUTYL ESTER	0.1061	91/06/03	0.566

Base B	225Q1	ACETIC ACID, ETHYL ESTER	0.1562	91/06/03	0.833
Base B	225Q1	ACETIC ACID, ETHYL ESTER	0.0214	94/05/27	0.0685
Base B	225Q1	ACETIC ACID, ETHYL ESTER	0.0429	94/05/27	0.1305
Base B	225Q1	ACETIC ACID, ETHYL ESTER	0.1425	94/05/27	0.2505
Base B	225Q1	ACETIC ACID, ETHYL ESTER	0.2031	94/05/27	0.3665
Base B	225Q1	BENZENE	0.0031	92/05/18	0.0457
Base B	225Q1	BENZENE	0.003	92/05/18	0.0342
Base B	225Q1	BENZENE, CHLORO-	78.1875	91/06/03	417
Base B	225Q1	BENZENE, ETHYL-	0.0624	91/06/03	0.333
Base B	225Q1	2-BUTANONE	11.2227	91/06/03	61.215
Base B	225Q1	2-BUTANONE	0.2077	92/02/04	0.6392
Base B	225Q1	2-BUTANONE	3.8914	92/06/02	9.8829
Base B	225Q1	CADMIUM	0.0006	92/05/26	0.0027
Base B	225Q1	CADMIUM	0.0007	92/05/26	0.003
Base B	225Q1	CADMIUM	0.0003	93/11/10	0.0003
Base B	225Q1	CADMIUM	0.0015	93/11/10	0.0016
Base B	225Q1	CADMIUM	0.0001	93/11/12	0.0001
Base B	225Q1	CADMIUM	0.001	93/11/16	0.0009
Base B	225Q1	CADMIUM	0.0003	93/11/16	0.0003
Base B	225Q1	CADMIUM	0.0003	93/11/16	0.0003
Base B	225Q1	CADMIUM	0.0001	93/12/01	0.0001
Base B	225Q1	CHROMIUM	0.0011	92/05/26	0.0045
Base B	225Q1	CHROMIUM	0.0011	92/05/26	0.0049
Base B	225Q1	CHROMIUM	0.0022	94/12/13	0.0343
Base B	225Q1	CHROMIUM	0.0114	94/12/13	0.0925
Base B	225Q1	COPPER	0.0005	94/07/18	0.0051
Base B	225Q1	COPPER	0.0007	94/07/27	0.0148
Base B	225Q1	COPPER	0.0004	94/07/27	0.0096
Base B	225Q1	COPPER	0.0004	94/07/27	0.0132
Base B	225Q1	COPPER	0.0011	94/12/13	0.0089
Base B	225Q1	ETHANE, 1,1,1-TRICHLORO	9.0943	91/05/30	218.26
Base B	225Q1	ETHANE, 1,1,1-TRICHLORO	11.4577	91/06/03	61.107
Base B	225Q1	ETHANE, 1,1,1-TRICHLORO	19.9019	94/05/27	35.913
Base B	225Q1	ETHANE, 1,1,1-TRICHLORO	4.6224	94/05/27	14.042
Base B	225Q1	ETHANE, 1,1,1-TRICHLORO	0.1269	94/05/27	0.3808
Base B	225Q1	ETHANE, 1,1,1-TRICHLORO	0.7555	94/05/27	2.4176
Base B	225Q1	ETHANE, 1,1,1-TRICHLORO	6.8054	94/05/27	11.965
Base B	225Q1	ETHYLENE, TRICHLORO-	3.3844	92/02/04	10.413
Base B	225Q1	IRON OXIDE	0.0063	94/07/18	0.0705
Base B	225Q1	IRON OXIDE	0.0039	94/07/18	0.0462
Base B	225Q1	IRON OXIDE	0.0079	95/01/12	0.2237
Base B	225Q1	ISOPROPYL ALCOHOL	0.4471	91/06/03	2.3847
Base B	225Q1	ISOPROPYL ALCOHOL	1.1944	92/05/26	10.817
Base B	225Q1	ISOPROPYL ALCOHOL	0.9024	92/06/02	2.2918
Base B	225Q1	ISOPROPYL ALCOHOL	53.3686	92/06/08	483.33
Base B	225Q1	ISOPROPYL ALCOHOL	0.0572	94/05/27	0.1716
Base B	225Q1	ISOPROPYL ALCOHOL	3.0665	94/05/27	5.3917
Base B	225Q1	ISOPROPYL ALCOHOL	0.1678	94/05/27	0.3029
Base B	225Q1	ISOPROPYL ALCOHOL	0.0357	94/05/27	0.1143
Base B	225Q1	ISOPROPYL ALCOHOL	0.0543	94/05/27	0.165
Base B	225Q1	JP-4 JET FUEL	0	92/05/18	0

Base B	225Q1	JP-4 JET FUEL	0	92/05/18	0
Base B	225Q1	MANGANESE	0.0005	94/12/13	0.0043
Base B	225Q1	MANGANESE	0.0001	95/01/12	0.0023
Base B	225Q1		2.6042	91/06/03	13.889
Base B	225Q1	TOLUENE	0.1145	92/02/04	0.3524
Base B	225Q1	ZINC OXIDE	0.0004	94/07/27	0.0145
Base B	225Q1	ZINC OXIDE	0.0013	94/07/27	0.0301
Base B	225Q1	ZINC OXIDE	0.002	94/12/13	0.0302
Base B	225Q1	ZINC OXIDE	0.0116	94/12/13	0.0944
Base B	225C2	BENZENE	0.0034	91/12/21	0.0543
Base B	225C2	BENZENE	0.0071	91/12/21	0.0566
Base B	225C2	BENZENE	0.0011	91/12/21	0.034
Base B	225C2	BENZENE	0.0078	91/12/21	0.0527
Base B	225C2	BENZENE	0.0011	91/12/21	0.034
Base B	225C2	BENZENE	0.0012	91/12/21	0.0399
Base B	225C2	BENZENE	0.002	91/12/21	0.0649
Base B	225C2	BENZENE	0.0011	91/12/21	0.0085
Base B	225C2	BENZENE	0.01	91/12/21	0.0684
Base B	225C2	BENZENE	0.0032	91/12/21	0.0511
Base B	225C2	BENZENE	0.0011	92/02/10	0.034
Base B	225C2	BENZENE	0.0011	92/12/21	0.034
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.3115	91/12/21	2.106
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.6231	91/12/21	9.9703
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.323	91/12/21	2.584
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	2.0658	91/12/21	66.105
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.3347	91/12/21	2.6773
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.1403	91/12/21	4.4887
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.9313	91/12/21	29.8
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	3.1099	91/12/21	99.518
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	1.6922	91/12/21	11.603
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.1024	91/12/21	1.6382
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.1179	92/02/10	3.7739
Base B	225C2	ETHANE, 1,1,1-TRICHLORO	0.0149	92/12/21	0.4755
Base B	225C2	JP-4 JET FUEL	3.5022	91/12/21	112.07
Base B	225C2	JP-4 JET FUEL	3.441	91/12/21	23.263
Base B	225C2	JP-4 JET FUEL	3.4409	91/12/21	55.055
Base B	225C2	JP-4 JET FUEL	3.5059	91/12/21	28.047
Base B	225C2	JP-4 JET FUEL	3.5059	91/12/21	112.19
Base B	225C2	JP-4 JET FUEL	3.5022	91/12/21	28.018
Base B	225C2	JP-4 JET FUEL	3.5022	91/12/21	112.07
Base B	225C2	JP-4 JET FUEL	3.5059	91/12/21	112.19
Base B	225C2	JP-4 JET FUEL	3.4114	91/12/21	54.582
Base B	225C2	JP-4 JET FUEL	3.4115	91/12/21	23.393
Base B	225C2	JP-4 JET FUEL	3.5059	92/02/10	112.19
Base B	225C2	JP-4 JET FUEL	3.5022	92/12/21	112.07
Base B	268A1	BENZENE		89/10/10	0.2748
Base B	268A1	BENZENE	0.0006	89/10/10	0.0006
Base B	268A1	BENZENE	0.5671	89/10/10	0.6272
Base B	268A1	BENZENE	0.3605	89/10/10	0.3978
Base B	268A1	ETHANE, 1,1,1-TRICHLORO	0.0015	89/10/10	0.0016
Base B	268A1	ETHANE, 1,1,1-TRICHLORO	0.0015	89/10/10	0.0016

Base B	268A1	ETHANE, 1,1,1-TRICHLORO		89/10/10	0.7093
Base B	268A1	ETHANE, 1,1,1-TRICHLORO	0.0015	89/10/10	0.0016
Base B	268A1	JP-4 JET FUEL	0.0314	89/10/10	0.035
Base B	268A1	JP-4 JET FUEL	0.0313	89/10/10	0.0345
Base B	268A1	JP-4 JET FUEL		89/10/10	15
Base B	268A1	JP-4 JET FUEL	0.0312	89/10/10	0.0345
Base B	268A1	JP-4 JET FUEL	0.875	91/07/03	1
Base B	268A1	JP-4 JET FUEL	14.3917	91/07/03	15.7
Base B	295A1			92/09/02	
Base B	295A1	ACETONE	0	90/12/18	0
Base B	295A1	ACETONE	0	90/12/19	0
Base B	295A1	ACETONE	0	90/12/19	0
Base B	295A1	BENZENE	0	90/12/19	0
Base B	295A1	BENZENE	0.0176	93/08/18	0.1594
Base B	295A1	JP-4 JET FUEL	0	90/12/19	0
Base B	295A1	JP-4 JET FUEL	2.0763	93/08/18	18.804
Base B	295A1	TOLUENE	0	90/12/18	0
Base B	295A1	TOLUENE	0	90/12/19	0
Base B	295A1	TOLUENE	0	90/12/19	0
Base B	42A1	BENZENE	1.1753	91/08/20	26.864
Base B	42A1	BENZENE	0.0093	92/11/19	0.2134
Base B	42A1	BENZENE	0.0333	92/11/19	1.6
Base B	42A1	BENZENE	0.0093	92/11/19	0.1358
Base B	42A1	BENZENE	0.009	92/11/19	0.0943
Base B	42A1	BENZENE	0.0101	92/11/19	0.373
Base B	42A1	JP-4 JET FUEL	45.8281	91/08/20	1047.5
Base B	42A1	JP-4 JET FUEL	1.9921	92/11/19	95.622
Base B	42A1	JP-4 JET FUEL	1.7013	92/11/19	38.886
Base B	42A1	JP-4 JET FUEL	1.7013	92/11/19	62.816
Base B	42A1	JP-4 JET FUEL	1.7012	92/11/19	24.745
Base B	42A1	JP-4 JET FUEL	1.6481	92/11/19	17.198
Base B	42A2	BENZENE	0.0025	91/08/20	0.0802
Base B	42A2	BENZENE	1.1753	91/08/20	26.864
Base B	42A2	JP-4 JET FUEL	45.8281	91/08/20	1047.5
Base B	42A2	JP-4 JET FUEL	0.5765	91/08/20	18.447
Base B	42A2	METHANE, DICHLORODIFLUORO-	24.7175	91/07/26	847.45
Base B	42A2	METHANE, DICHLORODIFLUORO-	8.2613	91/07/26	172.41
Base B	43A1	BENZENE	2.5269	91/05/29	2.6954
Base B	43A1	BENZENE	1.811	91/05/29	1.9318
Base B	43A1	BENZENE	7.1114	91/05/30	14.841
Base B	43A1	BENZENE	0.1763	91/05/30	0.2821
Base B	43A1	BENZENE	0.03	91/05/30	0.0479
Base B	43A1	BENZENE	1.7626	91/05/30	3.8456
Base B	43A1	BENZENE	3.2295	91/05/30	7.0461
Base B	43A1	BENZENE	5.1937	91/05/30	10.839
Base B	43A1	BENZENE	0.24	91/06/11	0.8662
Base B	43A1	BENZENE	0.4411	91/06/11	1.6039
Base B	43A1	BENZENE	0.0331	92/09/28	0.2524
Base B	43A1	BENZENE	0.0095	95/01/05	0.0297
Base B	43A1	BENZENE	0.896	95/01/05	7.1679
Base B	43A1	BENZENE	0.6935	95/01/05	6.2806

Base B	43A1	BENZENE	0.5657	95/01/05	5.5412
Base B	43A1	BENZENE	1.3006	95/01/05	5.3358
Base B	43A1	BENZENE	1.6855	95/01/05	50.566
Base B	43A1	BENZENE	0.0347	95/01/05	0.3144
Base B	43A1	BENZENE	0.0439	95/01/05	0.124
Base B	43A1	BENZENE	1.5694	95/01/05	5.022
Base B	43A1	BENZENE	0.2722	95/01/05	2.3752
Base B	43A1	BENZENE	0	95/01/05	0
Base B	43A1	BENZENE	0.5952	95/01/05	14.285
Base B	43A1	BENZENE	0.1045	95/01/05	1.6714
Base B	43A1	BENZENE	0.0304	95/01/05	0.6943
Base B	43A1	BENZENE	0.0114	95/01/05	0.1824
Base B	43A1	BENZENE	0.049	95/01/05	1.0234
Base B	43A1	BENZENE	0.026	95/01/10	0.0518
Base B	43A1	BENZENE	1.0218	95/01/10	28.851
Base B	43A1	BENZENE	0.3025	95/01/10	8.0679
Base B	43A1	BENZENE	0.2371	95/01/10	7.5858
Base B	43A1	BENZENE	0.4706	95/01/10	6.4538
Base B	43A1	BENZENE	0	95/01/10	0
Base B	43A1	BENZENE	0	95/01/10	0
Base B	43A1	BENZENE	0.0267	95/01/10	0.0524
Base B	43A1	BENZENE	0.3801	95/01/10	1.4141
Base B	43A1	BENZENE	1.4235	95/01/10	11.201
Base B	43A1	BENZENE	0.4401	95/01/10	1.6375
Base B	43A1	BENZENE	0.0042	95/01/10	0.0153
Base B	43A1	BENZENE	0.1542	95/01/10	1.8976
Base B	43A1	BENZENE	2.6987	95/01/10	9.8885
Base B	43A1	BENZENE	1.1574	95/01/10	4.3744
Base B	43A1	BENZENE	0.5747	95/01/10	16.227
Base B	43A1	BENZENE	3.2948	95/01/10	14.509
Base B	43A1	JP-4 JET FUEL	67.5975	91/05/29	72.104
Base B	43A1	JP-4 JET FUEL	83.8378	91/05/29	89.427
Base B	43A1	JP-4 JET FUEL	350.4002	91/05/30	731.27
Base B	43A1	JP-4 JET FUEL	5.1438	91/05/30	8.23
Base B	43A1	JP-4 JET FUEL	0.6062	91/05/30	0.97
Base B	43A1	JP-4 JET FUEL	199.7694	91/05/30	416.91
Base B	43A1	JP-4 JET FUEL	47.4787	91/05/30	103.59
Base B	43A1	JP-4 JET FUEL	14.2415	91/06/11	51.398
Base B	43A1	JP-4 JET FUEL	25.3891	91/06/11	92.324
Base B	43A1	JP-4 JET FUEL	1461.6		4127.3
Base B	55A1	BENZENE	0.0017	92/06/11	0.008
Base B	55A1	BENZENE	0.0019	92/06/11	0.0179
Base B	55A1	BENZENE	0.0065	92/06/11	0.2096
Base B	55A1	BENZENE	0.0019	92/06/11	0.0115
Base B	55A1	BENZENE	0.0018	92/06/11	0.0189
Base B	55A1	BENZENE	0.0019	92/06/11	0.0169
Base B	55A1	BENZENE	0.0019	92/06/11	0.0597
Base B	55A1	BENZENE	0.0002	92/06/11	0.0013
Base B	55A1	BENZENE	0.0918	93/04/22	0.3146
Base B	55A1	BENZENE	0.013	93/04/22	0.025
Base B	55A1	CADMIUM	0	93/03/03	0

Base B	55A1	CADMIUM	0	93/03/03	0
Base B	55A1	CADMIUM	0	93/03/09	0.0001
Base B	55A1	CADMIUM	0.0015	95/02/08	0.0058
Base B	55A1	CADMIUM	0.0015	95/02/08	0.0058
Base B	55A1	JP-4 JET FUEL	2.8633	92/06/11	13.607
Base B	55A1	JP-4 JET FUEL	3.1469	92/06/11	100.7
Base B	55A1	JP-4 JET FUEL	3.1468	92/06/11	100.69
Base B	55A1	JP-4 JET FUEL	3.1468	92/06/11	21.578
Base B	55A1	JP-4 JET FUEL	3.1468	92/06/11	19.365
Base B	55A1	JP-4 JET FUEL	3.1468	92/06/11	30.209
Base B	55A1	JP-4 JET FUEL	3.1468	92/06/11	28.499
Base B	55A1	JP-4 JET FUEL	3.1468	92/06/11	32.137
Base B	55A1	LEAD	0.0109	95/02/08	0.0437
Base B	55A1	LEAD	0.0109	95/02/08	0.0437
Base B	55A1	BENZENE			0.02712
Base B	55A1	JP-4 JET FUEL			1.1076
Base B	55A1	BENZENE			0.06272
Base B	55A1	JP-4 JET FUEL			3.7504
Base B	55A1	BENZENE			0.0784
Base B	55A1	JP-4 JET FUEL			3.521
Base B	55A1	BENZENE			0.01792
Base B	55A1	JP-4 JET FUEL			0.3679
Base B	39A1	ETHANE, 1,1,1-TRICHLORO	22.825	85/08/19	24.9
Base B	39A1	ETHANE, 1,1,1-TRICHLORO	14.7583	85/08/26	16.1
Base B	39A1	BENZENE			5.84
Base B	39A1	JP-4 JET FUEL			244.78
Base B	45A2	BENZENE	0.0025	91/08/20	0.0802
Base B	45A2	BENZENE	1.1753	91/08/20	26.864
Base B	45A2	JP-4 JET FUEL	45.8281	91/08/20	1047.5
Base B	45A2	JP-4 JET FUEL	0.5765	91/08/20	18.447
Base B	45A2	METHANE, DICHLORODIFLUORO-	24.7175	91/07/26	847.45
Base B	45A2	METHANE, DICHLORODIFLUORO-	8.2613	91/07/26	172.41
Base B	45B1	BENZENE	1.1753	91/08/20	26.864
Base B	45B1	BENZENE	0.0025	91/08/20	0.0802
Base B	45B1	BENZENE	0.8189	94/08/16	14.557
Base B	45B1	BENZENE	0.0001	94/08/16	0.002
Base B	45B1	JP-4 JET FUEL	45.8281	91/08/20	1047.5
Base B	45B1	JP-4 JET FUEL	0.5765	91/08/20	18.447
Base B	45B1	JP-4 JET FUEL	19.1976	94/08/16	341.29
Base B	45B1	JP-4 JET FUEL	0.0198	94/08/16	0.38
Base B	45B2	BENZENE	0.0025	91/08/20	0.0802
Base B	45B2	BENZENE	1.1753	91/08/20	26.864
Base B	45B2	JP-4 JET FUEL	45.8281	91/08/20	1047.5
Base B	45B2	JP-4 JET FUEL	0.5765	91/08/20	18.447
Base B	45B2	METHANE, DICHLORODIFLUORO-	24.7175	91/07/26	847.45
Base B	45B2	METHANE, DICHLORODIFLUORO-	8.2613	91/07/26	172.41
Base B	56A1			89/12/19	
Base B	56A1			89/12/19	
Base B	56A1			89/12/19	
Base B	56A1			92/06/11	
Base B	56A1			93/04/22	

Base B	56A1	ACETONE	2.4729	91/02/15	23.74
Base B	56A1	BARIUM	0	92/12/21	0.0005
Base B	56A1	BARIUM	0	92/12/21	0.0001
Base B	56A1	BENZENE	0.3446	91/02/19	7.876
Base B	56A1	BENZENE	0.0311	91/08/21	0.0747
Base B	56A1	BENZENE	0.0105	91/08/21	0.0228
Base B	56A1	BENZENE	11.9047	92/06/11	114.28
Base B	56A1	BENZENE	0.2433	92/06/11	2.0487
Base B	56A1	BENZENE	0.1637	92/06/11	1.0477
Base B	56A1	BENZENE	0.0427	92/06/11	2.0477
Base B	56A1	BENZENE	0.0018	92/06/11	0.0147
Base B	56A1	BENZENE	0.0179	92/06/11	0.1246
Base B	56A1	BENZENE	19.4887	92/06/11	161.28
Base B	56A1	BENZENE	0.4624	92/06/11	14.795
Base B	56A1	BENZENE	0.0028	93/04/22	0.0208
Base B	56A1	BENZENE	0.0171	93/04/22	0.1281
Base B	56A1	BENZENE	0.0168	93/04/22	0.1259
Base B	56A1	BENZENE	0.0328	93/04/22	0.2214
Base B	56A1	BENZENE	0.0053	93/04/22	0.0273
Base B	56A1	BENZENE	0.0531	93/04/22	0.6708
Base B	56A1	BENZENE	0.0522	93/04/22	0.6595
Base B	56A1	BENZENE	0.0016	93/04/22	0.0084
Base B	56A1	BENZENE	0.0333	93/04/22	0.2252
Base B	56A1	BENZENE	0.0311	93/04/22	0.3476
Base B	56A1	BENZENE	0.0029	93/05/24	0.0211
Base B	56A1	BENZENE	0.0119	93/05/24	0.1687
Base B	56A1	CADMIUM	0.0004	91/02/27	0.0013
Base B	56A1	CADMIUM	0.0013	91/02/27	0.004
Base B	56A1	CADMIUM	0	92/12/21	0.0005
Base B	56A1	CADMIUM	0.0002	92/12/21	0.002
Base B	56A1	CHROMIC ACID, LEAD(2+) SALT	0.007	91/02/15	0.067
Base B	56A1	CHROMIC ACID, LEAD(2+) SALT	0.0222	91/02/27	0.035
Base B	56A1	CHROMIC ACID, STRONTIUM SAL	0	92/12/21	0.0001
Base B	56A1	CHROMIC ACID, STRONTIUM SAL	0	92/12/21	0
Base B	56A1	CHROMIUM	0.0004	92/12/21	0.005
Base B	56A1	CHROMIUM	0	92/12/21	0.0002
Base B	56A1	COBALT	0.0003	91/02/27	0.001
Base B	56A1	COBALT	0.0005	91/02/27	0.0016
Base B	56A1	COPPER	0.0027	91/02/27	0.0089
Base B	56A1	COPPER	0.0059	91/02/27	0.0182
Base B	56A1	HEXANE	1.6741	91/02/19	38.264
Base B	56A1	IRON	0.0007	92/12/21	0.0089
Base B	56A1	IRON	0.0007	92/12/21	0.0089
Base B	56A1	IRON OXIDE	0.2309	91/02/27	0.7538
Base B	56A1	IRON OXIDE	0.5636	91/02/27	1.7452
Base B	56A1	JP-4 JET FUEL	3.0088	92/06/11	20.931
Base B	56A1	JP-4 JET FUEL	11.0231	92/06/11	92.826
Base B	56A1	JP-4 JET FUEL	3.0089	92/06/11	24.901
Base B	56A1	JP-4 JET FUEL	26.0089	92/06/11	832.28
Base B	56A1	JP-4 JET FUEL	351.8557	92/06/11	2911.9
Base B	56A1	JP-4 JET FUEL	3.0088	92/06/11	144.42

Base B	56A1	JP-4 JET FUEL	269.6406	92/06/11	2588.5
Base B	56A1	JP-4 JET FUEL	0	93/04/22	0
Base B	56A1	JP-4 JET FUEL	0	93/05/24	0
Base B	56A1	LEAD	0.0071	91/02/27	0.0219
Base B	56A1	LEAD	0.0037	91/02/27	0.012
Base B	56A1	LEAD	0.0002	92/12/21	0.002
Base B	56A1	LEAD	0.0002	92/12/21	0.002
Base B	56A1	MANGANESE	0.001	91/02/27	0.0032
Base B	56A1	MANGANESE	0.002	91/02/27	0.0063
Base B	56A1	METHANE, DICHLORO	0.5642	91/02/15	5.416
Base B	56A1	MOLYBDENUM	0.0012	91/02/27	0.0037
Base B	56A1	MOLYBDENUM	0.0005	91/02/27	0.0017
Base B	56A1	NICKEL	0.0031	91/02/27	0.0096
Base B	56A1	NICKEL	0.0011	91/02/27	0.0036
Base B	56A1	NICKEL	0.0002	92/12/21	0.002
Base B	56A1	NICKEL	0	92/12/21	0.0002
Base B	56A1	PETROLEUM DISTILLATE	10.1051	91/02/15	97.009
Base B	56A1	PETROLEUM DISTILLATE	20.4759	91/02/19	468.02
Base B	56A1	STODDARD SOLVENT	2.6031	91/02/19	59.5
Base B	56A1	TOLUENE	5.5077	91/02/15	52.874
Base B	56A1	TOLUENE	0.3486	91/02/19	7.967
Base B	56A1	XYLENE	0.1428	91/02/15	1.371
Base B	56A1	XYLENE	0.1204	91/02/19	2.751
Base B	56A1	ZINC OXIDE	0.0049	91/02/27	0.0159
Base B	56A1	ZINC OXIDE	0.0118	91/02/27	0.0364
Base B	56A1	BENZENE			0.2112
Base B	56A1	JP-4 JET FUEL			19.471
Base B	56A1	BENZENE			0.2973
Base B	56A1	JP-4 JET FUEL			12.822
Base B	56A1	BENZENE			0.048
Base B	56A1	JP-4 JET FUEL			4.025
Base B	56A1	BENZENE			0.02368
Base B	56A1	JP-4 JET FUEL			BDL
Base B	597J1	BENZENE	2.3367	91/11/12	3.8022
Base B	597J1	JP-4 JET FUEL	76.995	91/11/12	125.28
Base B	25C2	BENZENE	0.3521	91/03/07	0.3514
Base B	25C2	BENZENE	0.3522	91/03/07	0.3715
Base B	25C2	BENZENE	0.032	91/05/21	0.032
Base B	25C2	BENZENE	0.03	91/05/21	0.03
Base B	25C2	BENZENE	0.1042	91/05/23	0.1042
Base B	25C2	BENZENE	0.1121	91/05/23	0.1109
Base B	25C2	BENZENE	0.0307	91/05/24	0.0307
Base B	25C2	BENZENE	0.032	91/05/24	0.032
Base B	25C2	JP-4 JET FUEL	18.8251	91/03/07	18.786
Base B	25C2	JP-4 JET FUEL	18.8256	91/03/07	19.86
Base B	25C2	JP-4 JET FUEL	0.648	91/05/21	0.648
Base B	25C2	JP-4 JET FUEL	0.6419	91/05/21	0.6419
Base B	25C2	JP-4 JET FUEL	3.7266	91/05/23	3.7266
Base B	25C2	JP-4 JET FUEL	5.8584	91/05/23	5.798
Base B	25C2	JP-4 JET FUEL	0.2654	91/05/24	0.2654
Base B	25C2	JP-4 JET FUEL	0.642	91/05/24	0.642

Base B	25C2	METHANE, DICHLORODIFLUORO-	0.2935	91/03/07	28.173
Base B	Z168	BENZENE	0.168	90/07/12	0.1713
Base B	Z168	BENZENE	0.0587	90/07/12	0.0599
Base B	Z168	BENZENE	0.0587	90/07/12	0.0599
Base B	Z168	BENZENE		90/07/13	0.0626
Base B	Z168	BENZENE		90/07/13	0.0587
Base B	Z168	BENZENE		90/07/13	0.0626
Base B	Z168	BENZIN	37.6506	90/07/12	38.37
Base B	Z168	BENZIN	37.6509	90/07/12	38.452
Base B	Z168	BENZIN		90/07/13	40.161
Base B	Z168	BENZIN		90/07/13	40.161
Base B	Z168	BENZIN		90/07/13	37.651
Base B	Z168	ETHANE, 1,1,1-TRICHLORO	5.9389	90/07/12	6.0524
Base B	Z168	ETHANE, 1,1,1-TRICHLORO	1.3741	90/07/12	1.4033
Base B	Z168	ETHANE, 1,1,1-TRICHLORO	1.3511	90/07/12	1.3798
Base B	Z168	ETHANE, 1,1,1-TRICHLORO		90/07/13	0.79
Base B	Z168	ETHANE, 1,1,1-TRICHLORO		90/07/13	2.0422
Base B	Z168	ETHANE, 1,1,1-TRICHLORO		90/07/13	0.6514
Base B	Z168	JP-4 JET FUEL	37.6506	90/07/12	38.37
Base B	Z168	JP-4 JET FUEL	37.6509	90/07/12	38.452
Base B	Z168	JP-4 JET FUEL	37.6509	90/07/12	38.452
Base B	Z168	JP-4 JET FUEL		90/07/13	40.161
Base B	Z168	JP-4 JET FUEL		90/07/13	37.651
Base B	Z168	JP-4 JET FUEL		90/07/13	40.161
Base B	Z168	STODDARD SOLVENT	37.6509	90/07/12	38.452
Base B	Z168	TOLUENE	0.0664	90/07/12	0.0678
Base B	Z168	TOLUENE	0.0663	90/07/12	0.0676
Base B	Z168	TOLUENE	0.0664	90/07/12	0.0678
Base B	Z168	TOLUENE		90/07/13	0.0003
Base B	Z168	TOLUENE		90/07/13	0.0003
Base B	Z168	TOLUENE		90/07/13	0.0003
Base B	Z168	JP-4 JET FUEL			46.62
Base B	Z168	BENZENE			1.408
Base B	Z168	JP-4 JET FUEL			16.09
Base B	Z168	BENZENE			0.672
Base B	270A1			89/02/28	
Base B	270A1	ASBESTOS	0	89/04/28	0
Base B	270A1	ASBESTOS		89/04/28	0
Base B	270A1	BENZENE	0.0802	89/02/28	3.8504
Base B	270A1	BENZENE	0.2	89/02/28	9.6013
Base B	270A1	BENZENE	0.1271	89/02/28	6.1007
Base B	270A1	BENZENE	0.0531	89/02/28	2.5497
Base B	270A1	BENZENE	0.049	89/02/28	2.3503
Base B	270A1	BENZENE	0.0167	89/03/10	0.5336
Base B	270A1	BENZENE	0.0865	89/03/10	2.7682
Base B	270A1	BENZENE	0.0167	89/03/10	0.5336
Base B	270A1	BENZENE	0.0167	89/03/10	0.5336
Base B	270A1	BENZENE		89/03/10	7.8823
Base B	270A1	BENZENE	0.0925	89/03/10	2.9587
Base B	270A1	BENZENE	0.0166	89/03/10	0.5326
Base B	270A1	BENZENE		89/03/10	2.5462

Base B	270A1	BENZENE	0.0009	90/03/14	0.001
Base B	270A1	BENZENE	0.0009	90/03/14	0.001
Base B	270A1	BENZENE		90/03/15	0.001
Base B	270A1	BENZENE	2.0963	90/03/15	3.096
Base B	270A1	BENZENE	2.4017	90/03/15	3.2938
Base B	270A1	BENZENE		90/03/15	0.001
Base B	270A1	BENZENE	0.649	90/03/15	0.9585
Base B	270A1	BENZENE	0.6713	90/03/15	0.9339
Base B	270A1	BENZENE, TRIMETHYL- (MIXED I	0.0102	89/02/28	0.4917
Base B	270A1	BENZENE, TRIMETHYL- (MIXED I	0.0758	89/02/28	3.6383
Base B	270A1	BENZENE, TRIMETHYL- (MIXED I	0.0102	89/02/28	0.4917
Base B	270A1	BENZENE, TRIMETHYL- (MIXED I	0.0102	89/02/28	0.4917
Base B	270A1	BENZENE, TRIMETHYL- (MIXED I	0.0102	89/02/28	0.4917
Base B	270A1	BENZIN	2.2396	89/02/28	107.5
Base B	270A1	BENZIN	3.4885	89/02/28	167.45
Base B	270A1	BENZIN	1.4896	89/02/28	71.5
Base B	270A1	BENZIN	6.8365	89/02/28	328.15
Base B	270A1	BENZIN	1.9	89/02/28	91.2
Base B	270A1	BENZIN	4.5531	89/03/10	145.7
Base B	270A1	BENZIN	4.5531	89/03/10	145.7
Base B	270A1	BENZIN		89/03/10	145.7
Base B	270A1	BENZIN	4.5531	89/03/10	145.7
Base B	270A1	BENZIN		89/03/10	145.7
Base B	270A1	BENZIN	4.5531	89/03/10	145.7
Base B	270A1	BENZIN	4.5531	89/03/10	145.7
Base B	270A1	BENZIN	4.5531	89/03/10	145.7
Base B	270A1	2-BUTANONE	0.0017	90/03/14	0.002
Base B	270A1	2-BUTANONE	0.0018	90/03/14	0.002
Base B	270A1	2-BUTANONE		90/03/15	0.002
Base B	270A1	2-BUTANONE	1.7614	90/03/15	2.4506
Base B	270A1	ETHANE, 1,1,1-TRICHLORO	2.4902	90/03/14	2.7166
Base B	270A1	ETHANE, 1,1,1-TRICHLORO	2.247	90/03/14	2.5927
Base B	270A1	ETHANE, 1,1,1-TRICHLORO		90/03/15	0.003
Base B	270A1	ETHANE, 1,1,1-TRICHLORO	0.0022	90/03/15	0.003
Base B	270A1	JP-4 JET FUEL	0.0033	90/03/14	0.0036
Base B	270A1	JP-4 JET FUEL	0.0032	90/03/14	0.0036
Base B	270A1	JP-4 JET FUEL	0.9202	90/03/15	1.262
Base B	270A1	JP-4 JET FUEL	53.7604	90/03/15	79.4
Base B	270A1	JP-4 JET FUEL		90/03/15	0.0036
Base B	270A1	JP-4 JET FUEL		90/03/15	0.0036
Base B	270A1	JP-4 JET FUEL	132.3698	90/03/15	195.5
Base B	270A1	JP-4 JET FUEL	0.0026	90/03/15	0.0036
Base B	270A1	TOLUENE	0.1969	89/02/28	9.4502
Base B	270A1	TOLUENE	0.106	89/02/28	5.088
Base B	270A1	TOLUENE	0.3062	89/02/28	14.698
Base B	270A1	TOLUENE	0.101	89/02/28	4.8498
Base B	270A1	TOLUENE	0.1135	89/02/28	5.4499
Base B	270A1	TOLUENE		89/03/10	5.8098
Base B	270A1	TOLUENE		89/03/10	17.483
Base B	270A1	TOLUENE	0.0789	89/03/10	2.5252
Base B	270A1	TOLUENE	0.0789	89/03/10	2.5252

Base B	270A1	TOLUENE	0.1762	89/03/10	5.6375
Base B	270A1	TOLUENE	0.0789	89/03/10	2.5252
Base B	270A1	TOLUENE	0.1756	89/03/10	5.6198
Base B	270A1	TOLUENE	0.2095	89/03/10	6.7049
Base B	270A1	XYLENE	0.009	89/02/28	0.4343
Base B	270A1	XYLENE	0.209	89/02/28	10.031
Base B	270A1	XYLENE	0.009	89/02/28	0.4343
Base B	270A1	XYLENE	0.074	89/02/28	3.5502
Base B	270A1	XYLENE	0.009	89/02/28	0.4343
Base B	270A1	XYLENE		89/03/10	12.029
Base B	270A1	XYLENE	0.0909	89/03/10	2.9096
Base B	270A1	XYLENE	0.0209	89/03/10	0.67
Base B	270A1	XYLENE		89/03/10	0.67
Base B	270A1	XYLENE	0.0909	89/03/10	2.9096
Base B	270A1	XYLENE	0.0909	89/03/10	2.9096
Base B	270A1	XYLENE	0.0909	89/03/10	2.9096
Base B	270A1	XYLENE	0.0909	89/03/10	2.9096
Base E	015I-Z01	JP-4/5 JET FUEL	3.125	93/03/03	6
Base E	015I-Z01	JP-4/5 JET FUEL	20.9375	93/03/03	40.2
Base E	015I-Z01	JP-4/5 JET FUEL	5.1233	93/03/03	9.72
Base E	015I-Z01	JP-4/5 JET FUEL	5.6398	93/03/03	10.7
Base E	015I-Z01	JP-4/5 JET FUEL	3.1229	93/03/03	6.02
Base E	015I-Z01	JP-4/5 JET FUEL	388.5417	93/03/23	746
Base E	015I-Z01	BENZENE	0.0521	93/03/04	0.255
Base E	015I-Z01	JP-4/5 JET FUEL	0.3124	93/03/04	1.53
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.255
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.098
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.245
Base E	015I-Z01	JP-4/5 JET FUEL	3.1025	93/03/04	14.6
Base E	015I-Z01	N-HEXANE	0.077	93/03/04	0.385
Base E	015I-Z01	JP-4/5 JET FUEL	0.462	93/03/04	2.31
Base E	015I-Z01	BENZENE	0.0308	93/03/04	0.154
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.111
Base E	015I-Z01	N-HEXANE	2.6062	93/03/04	13.9
Base E	015I-Z01	JP-4/5 JET FUEL	5.1562	93/03/04	27.5
Base E	015I-Z01	N-HEXANE	9.0783	93/03/04	41.9
Base E	015I-Z01	BENZENE	4.1383	93/03/04	19.1
Base E	015I-Z01	JP-4/5 JET FUEL	66.5167	93/03/04	307
Base E	015I-Z01	BENZENE	3.4329	93/03/04	15.4
Base E	015I-Z01	JP-4/5 JET FUEL	54.8375	93/03/04	246
Base E	015I-Z01	N-HEXANE	6.2862	93/03/04	28.2
Base E	015I-Z01	BENZENE	0.0209	93/03/04	0.159
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.397
Base E	015I-Z01	JP-4/5 JET FUEL	2.1656	93/03/04	16.5
Base E	015I-Z01	N-HEXANE	5.1515	93/03/04	31.3
Base E	015I-Z01	JP-4/5 JET FUEL	21.3958	93/03/04	130
Base E	015I-Z01	BENZENE	1.7446	93/03/04	10.6
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.097
Base E	015I-Z01	N-HEXANE	4.9569	93/03/04	23.1
Base E	015I-Z01	JP-4/5 JET FUEL	21.6729	93/03/04	101
Base E	015I-Z01	N-HEXANE	3.4017	93/03/04	15.7

Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.096
Base E	015I-Z01	JP-4/5 JET FUEL	18.9583	93/03/04	87.5
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.137
Base E	015I-Z01	JP-4/5 JET FUEL	9.5356	93/03/04	62.7
Base E	015I-Z01	N-HEXANE	1.6425	93/03/04	10.8
Base E	015I-Z01	BENZENE	0.0209	93/03/04	0.108
Base E	015I-Z01	N-HEXANE	2.1119	93/03/04	10.9
Base E	015I-Z01	JP-4/5 JET FUEL	3.3712	93/03/04	17.4
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.238
Base E	015I-Z01	JP-4/5 JET FUEL	1.54	93/03/04	7.04
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.095
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.095
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.238
Base E	015I-Z01	JP-4/5 JET FUEL	1.5006	93/03/04	6.86
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.424
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.169
Base E	015I-Z01	JP-4/5 JET FUEL	0.6207	93/03/04	5.05
Base E	015I-Z01	BENZENE	0.0152	93/03/04	0.089
Base E	015I-Z01	JP-4/5 JET FUEL	2.255	93/03/04	13.2
Base E	015I-Z01	N-HEXANE	1.4453	93/03/04	8.46
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.09
Base E	015I-Z01	N-HEXANE	2.0928	93/03/04	9.05
Base E	015I-Z01	JP-4/5 JET FUEL	4.8331	93/03/04	20.9
Base E	015I-Z01	N-HEXANE	3.625	93/03/04	17.4
Base E	015I-Z01	JP-4/5 JET FUEL	20.1458	93/03/04	96.7
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.1
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.169
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.424
Base E	015I-Z01	JP-4/5 JET FUEL	1.9421	93/03/04	15.8
Base E	015I-Z01	BENZENE	0.0167	93/03/04	0.1
Base E	015I-Z01	N-HEXANE	3.1333	93/03/04	18.8
Base E	015I-Z01	JP-4/5 JET FUEL	10.3	93/03/04	61.8
Base E	015I-Z01	BENZENE	3.1967	93/03/04	13.7
Base E	015I-Z01	N-HEXANE	6.2767	93/03/04	26.9
Base E	015I-Z01	JP-4/5 JET FUEL	42.9333	93/03/04	184
Base E	015I-Z01	BENZENE	0.0208	93/03/04	0.096
Base E	015I-Z01	N-HEXANE	0.13	93/03/04	0.6
Base E	015I-Z01	JP-4/5 JET FUEL	17.0733	93/03/04	78.8
Base E	015I-Z01	BENZENE	0.0209	93/03/04	0.167
Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.417
Base E	015I-Z01	JP-4/5 JET FUEL	0.7913	93/03/04	6.33
Base E	015I-Z01	BENZENE	0.0205	93/03/04	0.147
Base E	015I-Z01	N-HEXANE	2.1915	93/03/04	15.7
Base E	015I-Z01	JP-4/5 JET FUEL	3.4477	93/03/04	24.7
Base E	015I-Z01	BENZENE	4.1629	93/03/04	19.4
Base E	015I-Z01	N-HEXANE	8.8194	93/03/04	41.1
Base E	015I-Z01	JP-4/5 JET FUEL	78.9667	93/03/04	368
Base E	015I-Z01	BENZENE	0.0207	93/03/04	0.088
Base E	015I-Z01	N-HEXANE	0.052	93/03/04	0.221
Base E	015I-Z01	JP-4/5 JET FUEL	16.8087	93/03/04	71.4
Base E	015I-Z01	BENZENE	0.0521	93/03/04	0.472

Base E	015I-Z01	N-HEXANE	0.0521	93/03/04	0.472
Base E	015I-Z01	JP-4/5 JET FUEL	0.7398	93/03/04	6.7
Base E	015I-Z01		0.6961	93/04/08	2.59
Base E	015I-Z01	BENZENE	0.0193	93/04/08	0.072
Base E	015I-Z01	N-HEXANE	0.0484	93/04/08	0.18
Base E	015I-Z01	BENZENE	0.0209	93/04/08	0.118
Base E	015I-Z01		0.3807	93/04/08	2.15
Base E	015I-Z01	N-HEXANE	0.0521	93/04/08	0.294
Base E	015I-Z01	BENZENE	0.0192	93/04/08	0.071
Base E	015I-Z01		0.5417	93/04/08	2
Base E	015I-Z01	N-HEXANE	0.0485	93/04/08	0.179
Base E	015I-Z01	IRON OXIDE DUST & FUME	0.5417	93/04/08	2
Base E	015I-Z01	BENZENE	0.0209	93/04/08	0.118
Base E	015I-Z01		1.677	93/04/08	9.47
Base E	015I-Z01	N-HEXANE	0.0521	93/04/08	0.294
Base E	015I-Z01	IRON OXIDE DUST & FUME	1.677	93/04/08	9.47
Base E	015I-Z01	NAPHTHALENE	1.7114	94/05/20	4.17
Base E	015I-Z01	BENZENE	5.5817	94/05/20	13.6
Base E	015I-Z01	BENZENE	0.1223	94/05/20	0.587
Base E	015I-Z01	NAPHTHALENE	0.0833	94/05/20	0.4
Base E	015I-Z01	BENZENE	0.1344	94/05/20	0.645
Base E	015I-Z01	NAPHTHALENE	0.0833	94/05/20	0.4
Base E	015I-Z01	2-METHOXYETHANOL		94/05/20	
Base E	015I-Z01	BENZENE	6.2083	94/05/20	29.8
Base E	015I-Z01	NAPHTHALENE	0.4813	94/05/20	2.31
Base E	015I-Z01	BENZENE	3.1211	94/05/20	8.71
Base E	015I-Z01	NAPHTHALENE	0.7525	94/05/20	2.1
Base E	015I-Z01	NAPHTHALENE	0.3388	94/05/20	1.07
Base E	015I-Z01	BENZENE	0.6872	94/05/20	2.17
Base E	015I-Z01	BENZENE	0.0433	94/11/17	0.16
Base E	015I-Z01	JP-4/5 JET FUEL	34.125	94/11/17	126
Base E	015I-Z01	BENZENE	0.2338	94/11/17	1.87
Base E	015I-Z01	JP-4/5 JET FUEL	31.125	94/11/17	249
Base E	015I-Z01	BENZENE	0.0209	94/11/17	0.077
Base E	015I-Z01	JP-4/5 JET FUEL	1.0427	94/11/17	3.85
Base E	015I-Z01	BENZENE	0.0209	94/11/17	0.167
Base E	015I-Z01	JP-4/5 JET FUEL	1.0413	94/11/17	8.33
Base E	015I-Z01	BENZENE	0.1394	95/01/10	0.234
Base E	015I-Z01	NAPHTHALENE	45.9983	95/01/10	77.2
Base E	015I-Z01	BENZENE	0.6218	95/01/10	1.04
Base E	015I-Z01	NAPHTHALENE	166.2208	95/01/10	278
Base E	015I-Z01	BENZENE	0.0417	95/01/10	0.073
Base E	015I-Z01	NAPHTHALENE	162.1167	95/01/10	284
Base E	015I-Z01	BENZENE	0.0414	95/01/10	0.069
Base E	015I-Z01	NAPHTHALENE	68.4	95/01/10	114
Base E	015I-Z01	BENZENE	1.1103	95/01/10	2.09
Base E	015I-Z01	NAPHTHALENE	326.7188	95/01/10	615
Base E	015I-Z01	JP-4/5 JET FUEL	34.125	94/11/17	86.21
Base E	015I-Z01	JP-4/5 JET FUEL	1.0427	94/11/17	2.6342
Base E	015I-Z01	BENZENE	0.0209	94/11/17	0.0527
Base E	015I-Z01	BENZENE	0.0433	94/11/17	0.1095

Base E	117A-Z01	HYDROGEN SULFIDE		93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01	HYDROGEN SULFIDE		93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01			93/05/19	
Base E	117A-Z01	PHENOL	0.0475	93/06/06	0.19
Base E	117A-Z01	PHENOL	0.1275	93/06/06	0.51
Base E	117A-Z01	CALCIUM OXIDE	0	93/12/01	0.0001
Base E	117A-Z01	METHYL CHLOROFORM	0.1353	94/02/07	0.151
Base E	117A-Z01	ENE	0.017	94/02/07	0.019
Base E	117A-Z01	TOLUENE	0.0448	94/02/07	0.05
Base E	117A-Z01	BENZENE	0.034	94/02/07	0.038
Base E	117A-Z01	TOLUENE	0.0444	94/02/07	0.05
Base E	117A-Z01	BENZENE	0.0346	94/02/07	0.039
Base E	117A-Z01	METHYL CHLOROFORM	0.0621	94/02/07	0.07
Base E	117A-Z01	ETHYL BENZENE	0.0169	94/02/07	0.019
Base E	117A-Z01	BENZENE	0.036	94/02/07	0.04
Base E	117A-Z01	TOLUENE	0.045	94/02/07	0.05
Base E	117A-Z01	ETHYL BENZENE	0.018	94/02/07	0.02
Base E	117A-Z01	METHYL CHLOROFORM	0.1431	94/02/07	0.159
Base E	117A-Z01	METHYLENE CHLORIDE	0.2064	94/02/16	0.508
Base E	117A-Z01	METHYLENE CHLORIDE	0.2009	94/02/16	0.524
Base E	117A-Z01	METHYLENE CHLORIDE	0.2009	94/03/01	0.524
Base E	117A-Z01	METHYLENE CHLORIDE	0.2025	94/02/16	0.543
Base E	117A-Z01	METHYLENE CHLORIDE	0.2085	94/02/16	4.55
Base E	117A-Z01	METHYLENE CHLORIDE	0.1896	94/02/16	4.55
Base E	117A-Z01	METHYLENE CHLORIDE	0.1983	94/02/16	4.76
Base E	117A-Z01	ETHYL BENZENE	0.0037	94/03/04	0.011
Base E	117A-Z01	BENZENE	0.0075	94/03/04	0.022
Base E	117A-Z01	TOLUENE	0.0037	94/03/04	0.011
Base E	117A-Z01	METHYL CHLOROFORM	0.0299	94/03/04	0.088
Base E	117A-Z01	BENZENE	0.008	94/03/04	0.024
Base E	117A-Z01	METHYL CHLOROFORM	0.0329	94/03/04	0.098
Base E	117A-Z01	ETHYL BENZENE	0.004	94/03/04	0.012

Base E	117A-Z01	TOLUENE	0.004	94/03/04	0.012
Base E	117A-Z01	ETHYL BENZENE	0.0041	94/03/04	0.012
Base E	117A-Z01	BENZENE	0.0081	94/03/04	0.024
Base E	117A-Z01	TOLUENE	0.0041	94/03/04	0.012
Base E	117A-Z01	METHYL CHLOROFORM	0.0326	94/03/04	0.096
Base E	117A-Z01	BENZENE		94/03/04	0.002
Base E	117A-Z01	ETHYL BENZENE		94/03/04	0.001
Base E	117A-Z01	TOLUENE		94/03/04	0.001
Base E	117A-Z01	METHYL CHLOROFORM		94/03/04	0.008
Base E	117A-Z01	ETHYL BENZENE	0.0036	94/03/04	0.012
Base E	117A-Z01	METHYL CHLOROFORM	0.0301	94/03/04	0.099
Base E	117A-Z01	TOLUENE	0.0036	94/03/04	0.012
Base E	117A-Z01	BENZENE	0.0076	94/03/04	0.025
Base E	117A-Z01	BENZENE	0.008	94/03/04	0.026
Base E	117A-Z01	METHYL CHLOROFORM	0.0318	94/03/04	0.104
Base E	117A-Z01	TOLUENE	0.004	94/03/04	0.013
Base E	117A-Z01	ETHYL BENZENE	0.004	94/03/04	0.013
Base E	117A-Z01	ETHYL BENZENE	0.0043	94/03/04	0.014
Base E	117A-Z01	BENZENE	0.0083	94/03/04	0.027
Base E	117A-Z01	TOLUENE	0.0043	94/03/04	0.014
Base E	117A-Z01	METHYL CHLOROFORM	0.0333	94/03/04	0.108
Base E	117A-Z01	BENZENE		94/03/04	0.002
Base E	117A-Z01	ETHYL BENZENE		94/03/04	0
Base E	117A-Z01	METHYL CHLOROFORM		94/03/04	0.008
Base E	117A-Z01	TOLUENE		94/03/04	0.001
Base E	117A-Z01	METHYL ETHYL KETONE	0.0417	94/03/11	1.25
Base E	117A-Z01	METHYL ETHYL KETONE	0.0417	94/03/11	1.43
Base E	117A-Z01	METHYL ETHYL KETONE	0.0417	94/03/11	1.43
Base E	117A-Z01	METHYL ETHYL KETONE		94/03/11	0.002
Base E	117A-Z01	BENZENE	0.1757	94/09/09	0.222
Base E	117A-Z01	ETHYL BENZENE	0.1148	94/09/09	0.145
Base E	117A-Z01	METHYL CHLOROFORM	0.8075	94/09/09	1.02
Base E	117A-Z01	TOLUENE	0.0997	94/09/09	0.126
Base E	117A-Z01	CHLOROFORM	0.1251	94/03/22	0.138
Base E	117A-Z01	STODDARD SOLVENT	2.0753	94/03/22	2.29
Base E	117A-Z01	PERCHLOROETHYLENE	0.3407	94/03/22	0.376
Base E	117A-Z01	ACETONE	0.1251	94/03/22	0.138
Base E	117A-Z01	STODDARD SOLVENT	1.5134	94/03/22	1.67
Base E	117A-Z01	CHLOROFORM	0.0906	94/03/22	0.1
Base E	117A-Z01	ACETONE	0.0906	94/03/22	0.1
Base E	117A-Z01	PERCHLOROETHYLENE	0.2429	94/03/22	0.268
Base E	117A-Z01	PERCHLOROETHYLENE	0.2429	94/03/22	0.268
Base E	117A-Z01	CHLOROFORM	0.0906	94/03/22	0.1
Base E	117A-Z01	STODDARD SOLVENT	1.5134	94/03/22	1.67
Base E	117A-Z01	ACETONE	0.0906	94/03/22	0.1
Base E	117A-Z01	ACETONE		94/03/22	0.003
Base E	117A-Z01	PERCHLOROETHYLENE		94/03/22	0.008
Base E	117A-Z01	CHLOROFORM		94/03/22	0.003
Base E	117A-Z01	STODDARD SOLVENT		94/03/22	0.05
Base E	117A-Z01	TOLUENE	0.0997	94/09/09	0.126
Base E	117A-Z01	BENZENE	0.1757	94/09/09	0.222

Base E	117A-Z01	METHYL CHLOROFORM	0.8075	94/09/09	1.02
Base E	117A-Z01	ETHYL BENZENE	0.1148	94/09/09	0.145
Base E	117A-Z01	ETHYL BENZENE	0.1148	94/09/09	0.145
Base E	117A-Z01	TOLUENE	0.0997	94/09/09	0.126
Base E	117A-Z01	BENZENE	0.1757	94/09/09	0.222
Base E	117A-Z01	METHYL CHLOROFORM	0.8075	94/09/09	1.02
Base E	117A-Z01	METHYL CHLOROFORM	0.8089	94/10/01	0.835
Base E	117A-Z01	BENZENE	0.1143	94/10/01	0.118
Base E	117A-Z01	TOLUENE	0.1763	94/10/01	0.182
Base E	117A-Z01	ETHYL BENZENE	0.0998	94/10/01	0.103
Base E	117A-Z01	ETHYL BENZENE	0.0998	94/10/01	0.103
Base E	117A-Z01	TOLUENE	0.1763	94/10/01	0.182
Base E	117A-Z01	BENZENE	0.1143	94/10/01	0.118
Base E	117A-Z01	METHYL CHLOROFORM	0.8089	94/10/01	0.835
Base E	117A-Z01	METHYLENE CHLORIDE	0.4163	94/10/22	3.33
Base E	117A-Z01	METHYLENE CHLORIDE	0.4625	94/10/22	3.7
Base E	117A-Z01	METHYLENE CHLORIDE	0.4163	94/10/22	3.33
Base E	117A-Z01	PHENOL	0.0475	93/06/06	0.095
Base E	117A-Z01	HYDROGEN SULFIDE		93/05/19	
Base E	201A-Z01	N-HEXANE	0.1037	93/12/07	0.149
Base E	201A-Z01	JP-4/5 JET FUEL	6.6174	93/12/07	9.51
Base E	201A-Z01	BENZENE	0.0564	93/12/07	0.081
Base E	201A-Z01	BENZENE	0.0633	93/12/07	0.094
Base E	201A-Z01	JP-4/5 JET FUEL	11.6684	93/12/07	17.34
Base E	201A-Z01	N-HEXANE	0.1534	93/12/07	0.228
Base E	201A-Z01	BENZENE	0.069	93/12/07	0.101
Base E	201A-Z01	JP-4/5 JET FUEL	8.9517	93/12/07	13.1
Base E	201A-Z01	N-HEXANE	0.1982	93/12/07	0.29
Base E	201A-Z01	JP-4/5 JET FUEL	1.5017	94/08/02	2.72
Base E	201A-Z01	BENZENE	0.0179	94/08/02	0.0325
Base E	201A-Z01	BENZENE	0.2362	94/08/03	0.36
Base E	201A-Z01	JP-4/5 JET FUEL	32.9437	94/08/03	50.2
Base E	201A-Z01	JP-4/5 JET FUEL	9.5812	94/08/03	14.6
Base E	201A-Z01	BENZENE	0.0728	94/08/03	0.111
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	0.2635	93/05/13	1.15
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	0.0975	93/05/13	0.4
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	7.1771	93/05/13	26.5
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	1.8475	93/05/13	7.39
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	0.2446	93/05/13	1.14
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETHYL		93/05/13	
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	4.0462	93/05/13	16.6
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	2.1397	93/05/13	9.17
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	35.7663	93/06/15	110.76
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	0.1787	93/06/15	0.33
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	0.1787	93/06/15	0.33
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	0.1787	93/06/15	0.33
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	0.1719	93/06/15	0.33
Base E	301A-Z02	BENZENE	0.155	93/08/20	1.24
Base E	301A-Z02	BENZENE	0.1808	93/08/20	1.24
Base E	301A-Z02	BENZENE		93/08/20	
Base E	301A-Z02	BENZENE	0.5667	93/08/20	3.2

Base E	301A-Z02	BENZENE		93/08/20	
Base E	301A-Z02	BENZENE	0.7013	93/08/20	3.96
Base E	301A-Z02	BENZENE	0.101	93/08/20	0.713
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETH	12.0229	93/06/15	57.71
Base E	301A-Z02			93/08/20	
Base E	301A-Z02			93/08/20	
Base E	301A-Z02			93/08/20	
Base E	301A-Z02	PROPYLENE GLYCOL MONOMETHYL		93/05/13	
Base E	003D-Z03	BENZENE	0.0948	93/11/30	0.222
Base E	003D-Z03	N-HEXANE	0.2375	93/11/30	0.556
Base E	003D-Z03	JP-4/5 JET FUEL	2.0329	93/11/30	4.76
Base E	003D-Z03	BENZENE	0.0758	93/11/30	0.182
Base E	003D-Z03	N-HEXANE	0.1896	93/11/30	0.455
Base E	003D-Z03	JP-4/5 JET FUEL	5.5	93/11/30	13.2
Base E	003D-Z03	BENZENE	0.0709	94/01/03	0.182
Base E	003D-Z03	N-HEXANE	0.1773	94/01/03	0.455
Base E	003D-Z03	JP-4/5 JET FUEL	1.1376	94/01/03	2.92
Base E	003D-Z03	BENZENE	0.0735	93/11/30	0.172
Base E	003D-Z03	N-HEXANE	0.1841	93/11/30	0.431
Base E	003D-Z03	JP-4/5 JET FUEL	2.1781	93/11/30	5.1
Base E	003D-Z03	BENZENE	0.0437	93/11/30	0.21
Base E	003D-Z03	N-HEXANE	0.0437	93/11/30	0.21
Base E	003D-Z03	JP-4/5 JET FUEL	6.0208	93/11/30	28.9
Base E	423A-Z01	N-HEXANE	0.3384	93/10/20	0.564
Base E	423A-Z01	BENZENE	0.0378	93/10/20	0.063
Base E	423A-Z01	JP-4/5 JET FUEL	5.472	93/10/20	9.12
Base E	423A-Z01	BENZENE	0.6352	93/09/20	1.03
Base E	423A-Z01	JP-4/5 JET FUEL	41.81	93/09/20	67.8
Base E	423A-Z01	N-HEXANE	4.3722	93/09/20	7.09
Base E	423A-Z01	JP-4/5 JET FUEL	54.8217	93/09/20	88.9
Base E	423A-Z01	BENZENE	0.436	93/09/20	0.707
Base E	423A-Z01	N-HEXANE	5.846	93/09/20	9.48
Base E	423A-Z01	BENZENE	4.107	93/09/20	6.66
Base E	423A-Z01	JP-4/5 JET FUEL		93/09/20	11.9
Base E	423A-Z01	BENZENE		93/09/20	11.6
Base E	423A-Z01	N-HEXANE		93/09/20	0.439
Base E	423A-Z01	N-HEXANE	25.7767	93/10/20	41.8
Base E	423A-Z01	BENZENE	4.107	93/10/20	6.66
Base E	423A-Z01	JP-4/5 JET FUEL	2.2817	93/10/20	3.7
Base E	423A-Z01	N-HEXANE	0.1197	93/12/07	0.16
Base E	423A-Z01	BENZENE	0.0494	93/12/07	0.066
Base E	423A-Z01	TOLUENE	0.1473	93/12/07	0.197
Base E	423A-Z01	JP-4/5 JET FUEL	1.1368	93/12/07	1.52
Base E	423A-Z01	N-HEXANE	0.1429	93/09/22	0.191
Base E	423A-Z01	BENZENE	0.0568	93/09/22	0.076
Base E	423A-Z01	TOLUENE	0.1713	93/09/22	0.229
Base E	423A-Z01	JP-4/5 JET FUEL	3.5676	93/09/22	4.77
Base E	423A-Z01	JP-4/5 JET FUEL	1.3014	93/09/22	1.74
Base E	423A-Z01	BENZENE	0.0583	93/09/22	0.078
Base E	423A-Z01	N-HEXANE	0.1458	93/09/22	0.195
Base E	423A-Z01	TOLUENE	0.1743	93/09/22	0.233

Base E	423A-Z01	JP-4/5 JET FUEL	0.8475	93/12/07	1.13
Base E	423A-Z01	BENZENE	0.1875	93/12/07	0.25
Base E	423A-Z01	N-HEXANE	0.4687	93/12/07	0.625
Base E	423A-Z01	TOLUENE	51.3	93/12/07	68.4
Base E	423A-Z01	TOLUENE	0.525	93/09/22	0.702
Base E	423A-Z01	BENZENE	0.175	93/09/22	0.234
Base E	423A-Z01	N-HEXANE	0.4375	93/09/22	0.585
Base E	423A-Z01	JP-4/5 JET FUEL	4.5025	93/09/22	6.02
Base E	423A-Z01			93/09/20	
Base F	B70A2	BENZENE			<.227
Base F	B70A2	BENZENE			<.167
Base F	B70A2	BENZENE			<.161
Base F	B70A2	BENZENE			<.161
Base F	B70A2	BENZENE			<.068
Base F	B70A2	BENZENE	<.111		<.095
Base F	B70A2	BENZENE			<.068
Base F	B70A2	BENZENE	<.066		<.095
Base F	C206D	BENZENE			<.182
Base F	C206D	BENZENE			<.118
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE	0.136		<.500
Base F	C206D	BENZENE			<.182
Base F	C206D	BENZENE			<.118
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE	0.084		<.002
Base F	C206D	JP-4			<.455
Base F	C206D	JP-4			<.294
Base F	C206D	JP-4			<.417
Base F	C206D	JP-4	27.33		<1.25
Base F	C206D	JP-4			<.455
Base F	C206D	JP-4			<.294
Base F	C206D	JP-4			<.417
Base F	C206D	JP-4			<.417
Base F	C206D	JP-4	0.209		<.005
Base F	C206D	BENZENE			<.91
Base F	C206D	BENZENE			<.125
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE	<.27		<.286
Base F	C206D	BENZENE			<.091
Base F	C206D	BENZENE			<.125
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE	0.09		<.286
Base F	C206D	JP-4			<.227
Base F	C206D	JP-4			<.313
Base F	C206D	JP-4			<.417
Base F	C206D	JP-4	<.21		<.714
Base F	C206D	JP-4			<.227
Base F	C206D	JP-4			<.313
Base F	C206D	JP-4			<.667

Base F	C206D	JP-4	<.25		<.714
Base F	C206D	BENZENE			<.100
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE	0.06		<.167
Base F	C206D	BENZENE			<.100
Base F	C206D	BENZENE			<.167
Base F	C206D	BENZENE	0.06		<.167
Base F	C206D	JP-4			<.250
Base F	C206D	JP-4			<.417
Base F	C206D	JP-4	0.16		<.417
Base F	C206D	JP-4			<.250
Base F	C206D	JP-4			<.417
Base F	C206D	JP-4	0.16		<.417
Base F	C4020B1,2	BENZENE	0.115		1.59
Base F	C4020B1,2	BENZENE			0.991
Base F	C4020B1,2	BENZENE			0.607
Base F	C4020B1,2	BENZENE			<.120
Base F	C4020B1,2	BENZENE			<.087
Base F	C4020B1,2	BENZENE			<.095
Base F	C4020B1,2	BENZENE			<.333
Base F	C29A1	BENZENE	0.28		
Base F	C29A1	BENZENE	0.02		
Base F	C29A1	BENZENE	0.05		
Base F	C29A1	BENZENE	0.068		
Base D	049A	JP-4 JET FUEL		89/01/12	<0.0020
Base D	049A	JP-4 JET FUEL		89/01/12	<0.0020
Base D	049A	JP-4 JET FUEL		89/01/12	<0.0020
Base D	049A	JP-4 JET FUEL		89/06/28	<0.0020
Base D	049A	JP-4 JET FUEL		90/01/31	0.005
Base D	049A	JP-4 JET FUEL		90/01/31	0.005
Base D	049A	JP-4 JET FUEL		90/01/31	0.005
Base D	049A	JP-4 JET FUEL		90/12/01	0.005
Base D	049A	JP-4 JET FUEL		90/07/11	<0.0050
Base D	049A	JP-4 JET FUEL		93/01/14	0.05
Base D	049A	JP-4 JET FUEL		93/01/15	0.05
Base D	049A	JP-4 JET FUEL		93/01/20	0.03
Base D	049A	JP-4 JET FUEL		93/01/21	0.03
Base D	049A	JP-4 JET FUEL		93/06/30	0.056
Base D	049A	JP-4 JET FUEL	196.875	89/01/12	225
Base D	049A	JP-4 JET FUEL	164.5	89/01/12	188
Base D	049A	JP-4 JET FUEL	623.5	89/06/28	688
Base D	049A	JP-4 JET FUEL	388.7813	89/06/28	429
Base D	049A	JP-4 JET FUEL	163.125	89/06/28	180
Base D	049A	JP-4 JET FUEL	32.6792	90/01/31	25.3
Base D	049A	JP-4 JET FUEL	34.0625	90/01/31	30
Base D	049A	JP-4 JET FUEL	34.0625	90/01/31	30
Base D	049A	JP-4 JET FUEL	28.3	90/02/01	28.3
Base D	049A	JP-4 JET FUEL	33.1	90/02/01	33.1
Base D	049A	JP-4 JET FUEL	31.3	90/02/01	31.3
Base D	049A	JP-4 JET FUEL	32.2917	90/02/01	25
Base D	049A	JP-4 JET FUEL	55.2833	90/02/01	42.8

Base D	049A	JP-4 JET FUEL	35.5208	90/02/01	27.5
Base D	049A	JP-4 JET FUEL	57.75	89/01/12	132
Base D	049A	JP-4 JET FUEL	43.75	89/01/12	100
Base D	049A	JP-4 JET FUEL	22.75	89/01/12	52
Base D	049A	JP-4 JET FUEL	22.75	89/01/12	52
Base D	049A	JP-4 JET FUEL	32.7688	90/01/31	107
Base D	049A	JP-4 JET FUEL	12.7698	90/01/31	94.3
Base D	049A	JP-4 JET FUEL	22.8375	90/01/31	75.6
Base D	049A	JP-4 JET FUEL	16.7417	90/01/31	98
Base D	049A	JP-4 JET FUEL	34.1323	90/01/31	75.5
Base D	049A	JP-4 JET FUEL	35.7183	90/01/31	73.9
Base D	049A	JP-4 JET FUEL	3.125	90/07/11	10
Base D	049A	JP-4 JET FUEL	9.7812	90/07/11	31.3
Base D	049A	JP-4 JET FUEL	0.3042	93/01/14	7.3
Base D	049A	JP-4 JET FUEL	0.225	93/01/14	6
Base D	049A	JP-4 JET FUEL	0.1469	93/01/14	4.7
Base D	049A	JP-4 JET FUEL	1.7708	93/01/15	17
Base D	049A	JP-4 JET FUEL	0.6977	93/01/15	3.94
Base D	049A	JP-4 JET FUEL	0.1762	93/01/15	2.82
Base D	049A	JP-4 JET FUEL	3.1387	93/01/15	83.7
Base D	049A	JP-4 JET FUEL		93/01/20	17
Base D	049A	JP-4 JET FUEL		93/01/21	
Base D	049A	JP-4 JET FUEL	107.8646	93/01/21	545
Base D	049A	JP-4 JET FUEL	3.1417	93/06/22	13
Base D	049A	JP-4 JET FUEL	4.35	93/06/22	18
Base D	049A	JP-4 JET FUEL	0.4167	93/06/22	5
Base D	049A	JP-4 JET FUEL	0.1325	93/06/23	5.3
Base D	049A	JP-4 JET FUEL	4.5671	93/06/23	19.4
Base D	049A	JP-4 JET FUEL	2.555	93/06/23	8.4
Base D	049A	JP-4 JET FUEL	1.8958	93/06/24	14
Base D	049A	JP-4 JET FUEL	3.1854	93/06/24	5.5
Base D	049A	JP-4 JET FUEL	0.7969	93/06/24	5.1
Base D	049A	JP-4 JET FUEL	1.6667	93/06/24	5
Base D	049A	JP-4 JET FUEL	32.9	93/06/24	32.9
Base D	049A	JP-4 JET FUEL	4.8583	93/06/25	5.3
Base D	049A	JP-4 JET FUEL	9.1	93/06/30	9.1
Base D	049A	JP-4 JET FUEL	10.2	93/06/30	10.2
Base D	049A	JP-4 JET FUEL	45.5	90/01/31	45.5
Base D	119L	JP-4 JET FUEL	0.0036	90/10/09	<0.0050
Base D	119L	JP-4 JET FUEL	30.8875	90/10/19	42
Base D	119L	JP-4 JET FUEL	28.5292	90/10/19	82
Base D	119L	JP-4 JET FUEL	29.025	90/11/08	40.5
Base D	119T	JP-4 JET FUEL		90/09/28	<0.0050
Base D	119T	JP-4 JET FUEL		90/10/01	<0.0050
Base D	119T	JP-4 JET FUEL		90/10/02	<0.0050
Base D	119T	JP-4 JET FUEL		90/10/05	<0.0050
Base D	119T	JP-4 JET FUEL		90/10/15	<0.0050
Base D	119T	JP-4 JET FUEL	9.9037	90/09/28	11.4
Base D	119T	JP-4 JET FUEL	1.1294	90/09/28	1.3
Base D	119T	JP-4 JET FUEL	64.174	90/10/02	67.7
Base D	119T	JP-4 JET FUEL	641.275	90/10/02	681

Base D	119T	JP-4 JET FUEL	100.0896	90/10/02	107
Base D	119T	JP-4 JET FUEL	172.825	90/10/02	186
Base D	119T	JP-4 JET FUEL	0.3255	90/10/05	<0.4101
Base D	119T	JP-4 JET FUEL	0.3255	90/10/05	<0.4090
Base D	119T	JP-4 JET FUEL	0.3349	90/10/05	<0.4090
Base D	119T	JP-4 JET FUEL	0.3222	90/10/05	<0.3946
Base D	119T	JP-4 JET FUEL	0.3288	10/10/05	<0.3986
Base D	119T	JP-4 JET FUEL	0.3255	90/10/15	<0.3511
Base D	119T	JP-4 JET FUEL	0.3255	90/10/15	<0.3503
Base D	119T	JP-4 JET FUEL	0.3255	90/10/15	<0.3503
Base D	119T	JP-4 JET FUEL	0.3255	90/10/15	<0.3480
Base D	119T	JP-4 JET FUEL	0.3248	90/10/15	<0.3472
Base D	119T	JP-4 JET FUEL	0.3255	90/10/15	<0.3464
Base D	119T	JP-4 JET FUEL	0.3255	90/10/15	<0.3457
Base D	119T	JP-4 JET FUEL	0.3255	90/10/15	<0.3457
Base D	119T	JP-4 JET FUEL	0.3255	90/10/05	<0.4037
Base D	119T	JP-4 JET FUEL	0.3255	90/10/05	<0.4664
Base D	119T	JP-4 JET FUEL	0.3255	90/10/05	<0.7440
Base D	119T	JP-4 JET FUEL	0.6588	90/10/05	<0.7440
Base D	119T	JP-4 JET FUEL	0.3981	90/10/05	<0.4496
Base D	119T	JP-4 JET FUEL	0.3255	90/11/16	<0.4377
Base D	119T	JP-4 JET FUEL	0.2572	90/10/05	<0.3468
Base D	119T	JP-4 JET FUEL	32.5313	90/10/01	1041
Base D	119T	JP-4 JET FUEL	34.9375	90/10/01	1118
Base D	119T	JP-4 JET FUEL	32.5938	90/10/01	1043
Base D	119T	JP-4 JET FUEL	32.9375	90/10/01	1054
Base D	151B	JP-4 JET FUEL	1.05	90/09/05	<1.2000
Base D	151B	JP-4 JET FUEL	7.0875	90/09/05	<8.1000
Base D	178A	JP-4 JET FUEL		91/05/08	<0.0050
Base D	178A	JP-4 JET FUEL	20.625	89/06/30	<22.000
Base D	178A	JP-4 JET FUEL	11.9	91/05/08	11.9
Base D	178A	JP-4 JET FUEL	11.7	91/05/08	11.7
Base D	178A	JP-4 JET FUEL	11.7	91/05/08	11.7
Base D	178A	JP-4 JET FUEL	9.6	91/05/08	<9.6000
Base D	585A	JP-4 JET FUEL		92/08/04	0.005
Base D	585A	JP-4 JET FUEL		92/08/11	0.005
Base D	585A	JP-4 JET FUEL	0.3134	92/08/04	0.398
Base D	585A	JP-4 JET FUEL	8.9775	92/08/04	11.4
Base D	585A	JP-4 JET FUEL	3.1338	92/08/04	3.99
Base D	585A	JP-4 JET FUEL	0.3141	92/08/04	0.401
Base D	585A	JP-4 JET FUEL	0.4856	92/08/11	1.05
Base D	585A	JP-4 JET FUEL	0.3168	92/08/11	0.688
Base D	585A	JP-4 JET FUEL	5.9583	92/08/11	13
Base D	673B	JP-4 JET FUEL		92/11/30	0.045
Base D	673B	JP-4 JET FUEL		92/12/02	0.045
Base D	673B	JP-4 JET FUEL		92/12/03	0.045
Base D	673B	JP-4 JET FUEL		92/12/04	0.045
Base D	673B	JP-4 JET FUEL	3.3031	91/10/22	3.5
Base D	673B	JP-4 JET FUEL	3.2087	91/10/22	3.4
Base D	673B	JP-4 JET FUEL	5.9456	91/10/22	6.3
Base D	673B	JP-4 JET FUEL	6.6063	91/10/22	7

Base D	673B	JP-4 JET FUEL	2.8239	92/11/30	15.58
Base D	673B	JP-4 JET FUEL	46.4042	92/12/04	301
Base D	673B	JP-4 JET FUEL	209.8688	92/12/02	1107
Base D	673B	JP-4 JET FUEL	13.6	92/12/02	128
Base D	673B	JP-4 JET FUEL	206.25	92/12/03	550
Base D	673B	JP-4 JET FUEL	167.825	92/12/03	588
Base D	673B	JP-4 JET FUEL	15.75	92/12/04	140
Base D	673B	JP-4 JET FUEL	85.4083	92/12/04	277
Base D	673B	JP-4 JET FUEL	33.1417	92/12/11	164
Base D	049A	BENZENE		89/01/12	<0.0020
Base D	049A	BENZENE		89/01/12	<0.0020
Base D	049A	BENZENE		89/01/12	<0.0020
Base D	049A	BENZENE		89/06/28	<0.0020
Base D	049A	BENZENE		90/01/31	<0.0020
Base D	049A	BENZENE		90/01/31	<0.0020
Base D	049A	BENZENE		90/01/31	<0.0020
Base D	049A	BENZENE		90/12/01	0.0909
Base D	049A	BENZENE		90/07/11	<0.0020
Base D	049A	BENZENE		91/07/16	0.002
Base D	049A	BENZENE		93/01/14	0.003
Base D	049A	BENZENE		93/01/15	0.003
Base D	049A	BENZENE		93/01/20	0.002
Base D	049A	BENZENE		93/01/21	0.03
Base D	049A	BENZENE		93/06/24	0.004
Base D	049A	BENZENE		93/06/30	0.003
Base D	049A	BENZENE	1.75	89/01/12	2
Base D	049A	BENZENE	0.875	89/01/12	1
Base D	049A	BENZENE	4.5313	89/06/28	5
Base D	049A	BENZENE	3.625	89/06/28	4
Base D	049A	BENZENE	0.9063	89/06/28	1
Base D	049A	BENZENE	0.1335	90/01/31	0.1034
Base D	049A	BENZENE	0.1174	90/01/31	0.1034
Base D	049A	BENZENE	0.1174	90/01/31	0.1034
Base D	049A	BENZENE	0.1174	90/02/01	0.1174
Base D	049A	BENZENE	1.1	90/02/01	1.1
Base D	049A	BENZENE	0.1174	90/02/01	0.1174
Base D	049A	BENZENE	0.1174	90/02/01	0.0909
Base D	049A	BENZENE	0.1174	90/02/01	0.0909
Base D	049A	BENZENE	0.1174	90/02/01	0.0909
Base D	049A	BENZENE	1.75	89/01/12	4
Base D	049A	BENZENE	1.75	89/01/12	4
Base D	049A	BENZENE	0.875	89/01/12	2
Base D	049A	BENZENE	0.875	89/01/12	2
Base D	049A	BENZENE	0.0379	90/01/31	0.1237
Base D	049A	BENZENE	0.0379	90/01/31	0.2797
Base D	049A	BENZENE	0.0347	90/01/31	0.1149
Base D	049A	BENZENE	0.0347	90/01/31	0.2032
Base D	049A	BENZENE	0.1174	90/01/31	0.2596
Base D	049A	BENZENE	0.1174	90/01/31	0.2428
Base D	049A	BENZENE	0.1174	90/07/11	<0.3756
Base D	049A	BENZENE	0.1174	90/07/11	0.3756

Base D	049A	BENZENE	0.0585	91/07/16	0.156
Base D	049A	BENZENE	0.0585	91/07/16	0.156
Base D	049A	BENZENE	0.25	93/01/14	8
Base D	049A	BENZENE	0.1762	93/01/14	4.23
Base D	049A	BENZENE	0.1759	93/01/14	4.69
Base D	049A	BENZENE	0.1759	93/01/14	5.63
Base D	049A	BENZENE	0.176	93/01/15	1.69
Base D	049A	BENZENE	0.176	93/01/15	0.994
Base D	049A	BENZENE	0.4887	93/01/15	7.82
Base D	049A	BENZENE	0.1759	93/01/15	4.69
Base D	049A	BENZENE		93/01/20	2.67
Base D	049A	BENZENE		93/01/21	
Base D	049A	BENZENE	0.2949	93/01/21	1.49
Base D	049A	BENZENE	0.0485	93/06/24	2.33
Base D	049A	BENZENE	0.0485	93/06/24	2.33
Base D	049A	BENZENE	0.1776	93/06/22	0.735
Base D	049A	BENZENE	0.1776	93/06/22	0.735
Base D	049A	BENZENE	0.1775	93/06/22	2.13
Base D	049A	BENZENE	0.1775	93/06/23	7.1
Base D	049A	BENZENE	0.1947	93/06/23	0.827
Base D	049A	BENZENE	0.1776	93/06/23	0.584
Base D	049A	BENZENE	0.1774	93/06/24	1.31
Base D	049A	BENZENE	0.2317	93/06/24	0.4
Base D	049A	BENZENE	0.1781	93/06/24	1.14
Base D	049A	BENZENE	0.1777	93/06/24	0.533
Base D	049A	BENZENE	0.178	93/06/24	0.178
Base D	049A	BENZENE	0.2237	93/06/25	0.244
Base D	049A	BENZENE	0.237	93/06/30	0.237
Base D	049A	BENZENE	0.237	93/06/30	0.237
Base D	064B	BENZENE		93/04/28	
Base D	119L	BENZENE	0.0014	90/10/09	<0.0020
Base D	119L	BENZENE	0.2934	90/10/19	0.399
Base D	119L	BENZENE	0.1174	90/10/19	0.3373
Base D	119L	BENZENE	0.3759	90/11/08	0.5246
Base D	119T	BENZENE		90/09/28	<0.0020
Base D	119T	BENZENE		90/10/01	<0.0020
Base D	119T	BENZENE		90/10/02	<0.0020
Base D	119T	BENZENE		90/10/05	<0.0020
Base D	119T	BENZENE		90/10/15	<0.0020
Base D	119T	BENZENE	0.1174	90/09/28	<0.1351
Base D	119T	BENZENE	0.1174	90/09/28	<0.1351
Base D	119T	BENZENE	0.1174	90/10/02	<0.1238
Base D	119T	BENZENE	0.3521	90/10/02	<0.3739
Base D	119T	BENZENE	0.1761	90/10/02	0.1882
Base D	119T	BENZENE	0.1174	90/10/02	0.1263
Base D	119T	BENZENE	0.1171	90/10/05	<0.1475
Base D	119T	BENZENE	0.1174	90/10/05	<0.1475
Base D	119T	BENZENE	0.1207	90/10/05	<0.1475
Base D	119T	BENZENE	0.1174	90/10/05	<0.1437
Base D	119T	BENZENE	0.1174	10/10/05	<0.1423
Base D	119T	BENZENE	0.1174	90/10/15	<0.1266

Base D	119T	BENZENE	0.1174	90/10/15	<0.1263
Base D	119T	BENZENE	0.1174	90/10/15	<0.1263
Base D	119T	BENZENE	0.1174	90/10/15	<0.1255
Base D	119T	BENZENE	0.1171	90/10/15	<0.1252
Base D	119T	BENZENE	0.1174	90/10/15	<0.1249
Base D	119T	BENZENE	0.1174	90/10/15	<0.1246
Base D	119T	BENZENE	0.1174	90/10/15	<0.1246
Base D	119T	BENZENE	0.1174	90/10/05	<0.1456
Base D	119T	BENZENE	0.1174	90/10/05	<0.1682
Base D	119T	BENZENE	0.1174	90/10/05	<0.2683
Base D	119T	BENZENE	0.1174	90/10/05	<0.1326
Base D	119T	BENZENE	0.1174	90/10/05	<0.1326
Base D	119T	BENZENE	0.1174	90/11/16	<0.1578
Base D	119T	BENZENE	0.1174	90/10/05	<0.1582
Base D	119T	BENZENE	0.1187	90/10/01	<3.8000
Base D	119T	BENZENE	0.1187	90/10/01	<3.8000
Base D	119T	BENZENE	0.1187	90/10/01	<3.8000
Base D	119T	BENZENE	0.1187	90/10/01	<3.8000
Base D	151B	BENZENE		90/09/05	<0.0020
Base D	151B	BENZENE	0.18	90/09/05	<0.1878
Base D	151B	BENZENE	0.18	90/09/05	<0.1878
Base D	151B	BENZENE	0.1213	90/09/05	<0.1266
Base D	151B	BENZENE		89/09/08	<0.0000
Base D	151B	BENZENE		89/09/08	<0.0000
Base D	151B	BENZENE	0.1661	90/09/05	<0.1733
Base D	178A	BENZENE		91/05/08	<0.0020
Base D	178A	BENZENE	15.9375	89/06/30	<17.000
Base D	178A	BENZENE	0.1174	91/05/08	<0.1174
Base D	178A	BENZENE	0.1174	91/05/08	<0.1174
Base D	178A	BENZENE	0.1174	91/05/08	<0.1174
Base D	178A	BENZENE	0.1174	91/05/08	<0.1174
Base D	585A	BENZENE		92/08/04	0.002
Base D	585A	BENZENE		92/08/11	0.002
Base D	585A	BENZENE	0.1173	92/08/04	0.149
Base D	585A	BENZENE	0.1173	92/08/04	0.149
Base D	585A	BENZENE	0.117	92/08/04	0.149
Base D	585A	BENZENE	0.1175	92/08/04	0.15
Base D	585A	BENZENE	0.1808	92/08/11	0.391
Base D	585A	BENZENE	0.1183	92/08/11	0.257
Base D	585A	BENZENE	0.1183	92/08/11	0.258
Base D	673B	BENZENE		91/10/22	<0.0020
Base D	673B	BENZENE		91/10/23	0.002
Base D	673B	BENZENE		92/11/30	0.003
Base D	673B	BENZENE		92/12/02	0.003
Base D	673B	BENZENE		92/12/03	0.003
Base D	673B	BENZENE		92/12/04	0.0075
Base D	673B	BENZENE	0.1174	91/10/22	<0.1244
Base D	673B	BENZENE	0.1174	91/10/22	<0.1244
Base D	673B	BENZENE	0.1174	91/10/22	<0.1244
Base D	673B	BENZENE	0.1174	91/10/22	<0.1244
Base D	673B	BENZENE	0.1174	91/10/23	0.1398

Base D	673B	BENZENE	0.1174	91/10/23	0.1398
Base D	673B	BENZENE	0.1174	91/10/23	0.1448
Base D	673B	BENZENE	0.1174	91/10/23	0.1448
Base D	673B	BENZENE	0.1175	92/11/30	0.648
Base D	673B	BENZENE	0.5365	92/12/04	3.48
Base D	673B	BENZENE	4.3604	92/12/02	23
Base D	673B	BENZENE	0.178	92/12/02	1.675
Base D	673B	BENZENE	2.6062	92/12/03	6.95
Base D	673B	BENZENE	3.1967	92/12/03	11.2
Base D	673B	BENZENE	0.1761	92/12/04	1.565
Base D	673B	BENZENE	1.2796	92/12/04	4.15
Base D	673B	BENZENE	0.1495	92/12/11	0.74

Appendix L

Industrial Hygiene Procedures:

Nitro-PAH Analysis

INDUSTRIAL HYGIENE PROCEDURES:

COLLECTION AND ANALYSIS PROTOCOL FOR NITRO-PAH

1. **Analytical Strategy for the Total Particulate and Nitro-PAH Analysis by ^{32}P-Postlabelling**

a. Analysis of Total Particulate: Filters will be pre-weighed in the Biomonitoring Lab and delivered to the industrial hygienist prior to sampling.

i. Equipment

(1) Mettler Type M5 SA, 6 place electronic balance.

(2) Forceps

(3) Filters: SKC 225-17-04 PTFE (teflon) with polypropylene web supports

(4) Filter holders: SKC 225-4 opaque polystyrene

ii. Gravimetric Procedure

(1) Assign and mark numbers on each filter holder

(2) Remove a filter from the pack using

forceps

(3) Place filter in weighing chamber and weigh according to balance instructions

(4) record the weight and remove the filter, placing it directly into a cassette. Seal the cassette. Note the number of the cassette on data sheet along with the filter weight. Do all filters needed for analysis.

(5) When samples return. Place filter cassettes in desiccator, sealed overnight.

(6) Note the number of the sample; Release the filter from the holder and weigh the sample as before. Record the post-sampling weight. Deduct the pre-sampling weight from the post-sampling weight and report this as net sample weight. Place the filter in a numbered 50 mm Petri dish which should be labelled, taped shut and placed in a -20°C freezer until analysis.

b. Analysis of Nitro-PAH DNA adducts *in vitro*: The following is a protocol for indirect analysis of

nitro-PAH in jet exhaust particulate using *in vitro* exposure of human lymphocytes to the polar extracts of the total particulate.

i. Extraction Procedure

(1) Extractions will be as reported by Savard, Otson and Douglas (1992).

(2) Remove filters from Petri dish noting the number. Place the filter in a 14 ml amber glass vial, add 8 ml of ether and sonicate for thirty minutes at room temperature.

(3) Pipette away the solvent to a numbered 30 ml amber tube, add 4 ml of ether and 4 ml of methanol to the original tube and repeat the sonication for another 30 minutes. Remove solvent to the storage tube and add an additional 8 ml of methanol to the filter and sonicate as above.

(4) Remove the solvent and centrifuge the combined sample at 3600 X g for 5 minutes. Carefully remove the supernate and filter under vacuum through a 0.46 µm pore filter.

(5) Remove the solvent under a gentle nitrogen flow and resuspend the residual with 10 ml DMSO.

ii. *In vitro* Exposure of Human Lymphocytes.

(1) Peripheral blood lymphocytes will be obtained from a single human donor and kept frozen at -80°C. Cells will be maintained at a concentration of 4.0 X 10^6 cells/ml of RPMI 1640 media made 10% with fetal calf serum. Sixteen million cells (4 ml) will be treated with 0.1 ml of the DMSO solution containing the particulate extracts.

(2) Cells will be treated for 24 hours, then centrifuged at 1000 X g for 10 minutes, washed twice with ice cold 10 mM Tris-HCl buffer pH 7.6 and either frozen at -80°C or processed immediately.

(3) DNA will be isolated using enzymatic digestion and solvent extraction as described in earlier publications (Gupta, R.C., Earley, K., and Sharma, S. (1988)).

(4) DNA samples will be ^{32}P-postlabelled

using carrier free labelling for the nitro-PAH as we have described earlier (Delclos, et al, Talaska, et al). We have standards for the following nitro-PAH modified DNAs: 1-nitropyrene, 6-nitrochrysene, 1,6-dinitropyrene, 1,8-dinitropyrene, and 1-nitrobiphenyl.

(5) Migration of the adducts in cells exposed to the extracts will be compared to that of standards. Adducts will be quantitated by measuring the radioactivity and comparing this to the total DNA analyzed. In addition, the adduct levels will be compared to the level of total particulate.

Appendix M

Acronym Definitions

Acronym/Symbol	Definition
AFB	Air Force Base
AFSC/OS	Air Force Service Code/Occupational Series
AIHA	American Industrial Hygiene Association
ACGIH	American Conference of Governmental Industrial Hygienists
AFOSH	Air Force Occupational Safety and Health
BEE	bioenvironmental Engineering
CIH	Certified Industrial Hygienist
DOD	Department of Defense
EC	Eyes Closed, Standing on Base Force Platform
EO	Eyes Open, Standing on Base Force Platform
FC	Eyes Closed, Standing on 4 Inch Foam Covered Platform
FO	Eyes Open, Standing on 4 Inch Foam Covered Platform
FSH	Follicle Stimulating Hormone
IH	Industrial Hygiene
JP-4	Jet Propellant-4 produced from refined crude petroleum
JP-5	Jet Propellant-5. A kerosene-based distillate and may be used as a purging fluid in aircraft fuel tanks.
JP-7	Jet Propellant-7. A kerosene-based distillate.
JP-8	Jet Propellant-8. A kerosene-based distillate with a high flash point, high chain hydrocarbons and no benzene.
JP-10	Jet Propellant-10. A missile fuel.
MPC	Military Personnel Center
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
SAS	Statistical Analysis System
STEL	Short-term Exposure Limit
TLV	Threshold Limit Value
TWA	Time Weighted Average
UCCC	University of Cincinnati Computer Center
USAF	United States Air Force

Paid Personnel:

Christine Clark
Rhonda Flora
Marlene Jaeger
Grace Lemasters, Ph.D.
James Lockey, M.D., M.S.
John Lu, M.S.
Donna Olson, Ph.D.
Edward Puhala
Susan Simpson, M.P.H.
Karen Williams
Glen Talaska, Ph.D.

List of Publications and Abstracts

Publications:

E. Puhala, G. Lemasters, L. Smith, G. Talaska, S. Simpson, J. Joyce, K. Trinh, J. Lu. An exposure evaluation of jet fuels related positions at United States Air Force base locations (in press).

L. Smith, A. Bhattacharya, G. Lemasters, P. Succop, E. Puhala, M. Medvedovic, J. Joyce. Effect of chronic low level exposure to jet fuel on postural balance of U.S. Air Force personnel (submitted).

Meeting Abstracts:

L. Smith, E. Puhala, A Bhattacharya, G. Lemasters, M. Medvedovic, J. Joyce. Effect of chronic low level exposure to jet fuel on postural balance of U.S. Air Force personnel. American Industrial Hygiene Conference and Exposition, Student Poster Presentation. Washington, D.C., Fairfax, VA: May 18-24, 1996.

L. Smith, E. Puhala, A Bhattacharya, G. Lemasters, M. Medvedovic, J. Joyce. Effect of chronic low level exposure to jet fuel on postural balance of U.S. Air Force personnel. Triservice (DoD) Risk Assessment of Toxicology Conference. Wright Patterson AFB, OH: April 23, 1996.

L. Smith, E. Puhala, A Bhattacharya, G. Lemasters, M. Medvedovic, J. Joyce. Effect of chronic low level exposure to jet fuel on postural balance of U.S. Air Force personnel. Tristate Human Factors and Ergonomics Society. Northern Kentucky University: April 24, 1996.

DEPARTMENT OF THE ARMY
US ARMY MEDICAL RESEARCH AND MATERIEL COMMAND
504 SCOTT STREET
FORT DETRICK, MARYLAND 21702-5012

REPLY TO
ATTENTION OF:

MCMR-RMI-S (70-1y) 9 Mar 98

MEMORANDUM FOR Administrator, Defense Technical Information Center, ATTN: DTIC-OCP, Fort Belvoir, VA 22060-6218

SUBJECT: Request Change in Distribution Statement

1. The U.S. Army Medical Research and Materiel Command has reexamined the need for the limitation assigned to technical reports written for the following contracts. Request the limited distribution statement for these contracts be changed to "Approved for public release; distribution unlimited." These reports should be released to the National Technical Information Service.

Contract Number	Accession Document Number
DAMD17-94-J-4407	ADB224557
DAMD17-95-1-5048	ADB230013
DAMD17-95-C-5006	ADB219041
95MM5508	ADB227588
95MM5522	ADB229897
95MM5537	ADB227721
95MM5596	ADB229924
96MM6652	ADB220033
96MM6653	ADB221466
96MM6654	ADB222409

2. Point of contact for this request is Ms. Betty Nelson at DSN 343-7328 or email: betty_nelson@ftdetrck-ccmail.army.mil.

FOR THE COMMANDER:

Phyllis Rinehart

PHYLLIS M. RINEHART
Deputy Chief of Staff for
Information Management

Completed
7-8-2000
B.W